بسم الله الرحمن الرحيم

BIOCHEMISTRY

Lecture #23

Plasma Proteins

﴿ وَإِن تَتَوَلَّوْا۟ يَسْتَبْدِلْ قَوْمًا غَيْرَكُمْ ثُمَّ لَا يَكُونُوٓا۟ أَمْثَٰلَكُم ﴾

اللهم استعملنا لنصرة دينك

Written by:

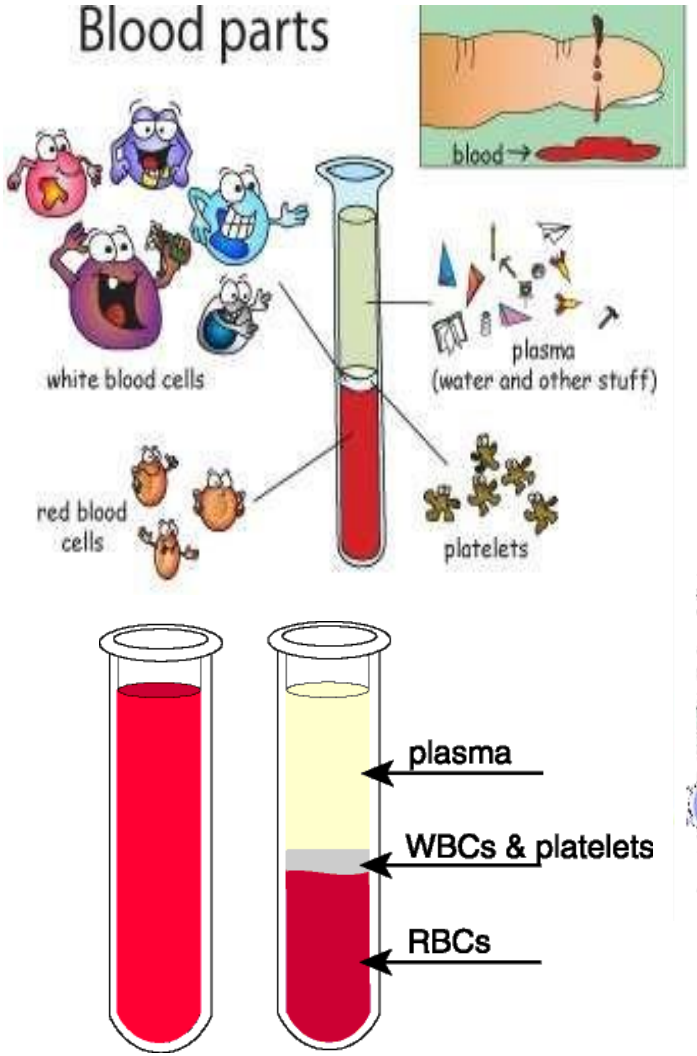
Leen Mamoon and Hala Swiedan

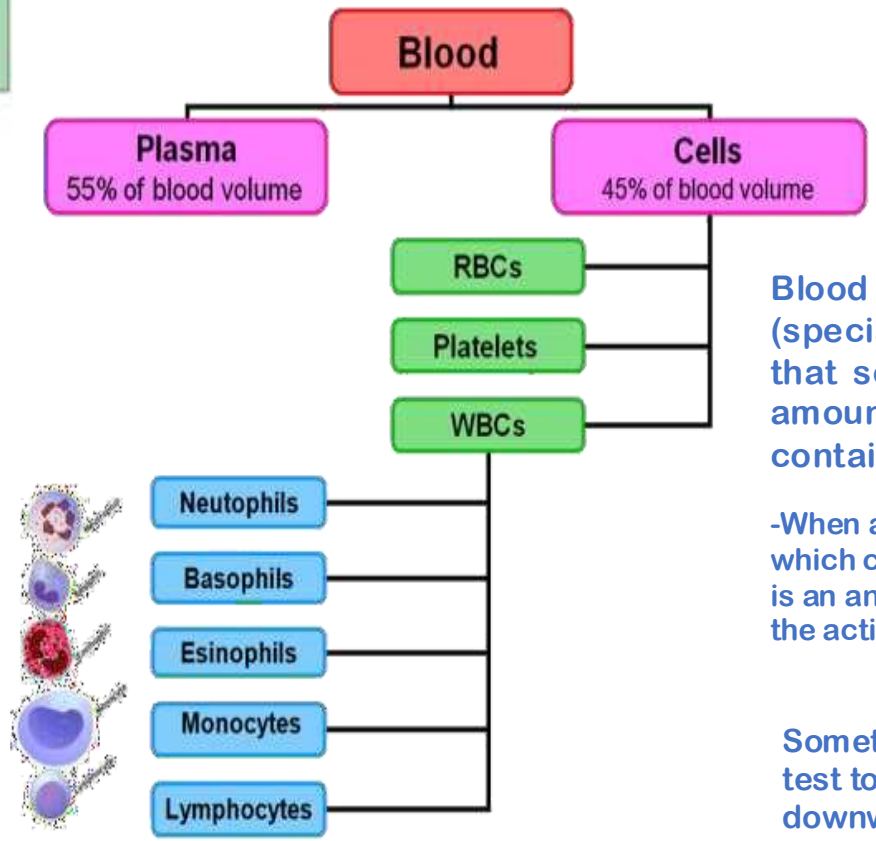
Edited by:

Raghad Hamdan

Blood

"اللهم أنت عضدي ونصيري، بك أحاول، وبك أصاول ، وبك أقاتل"





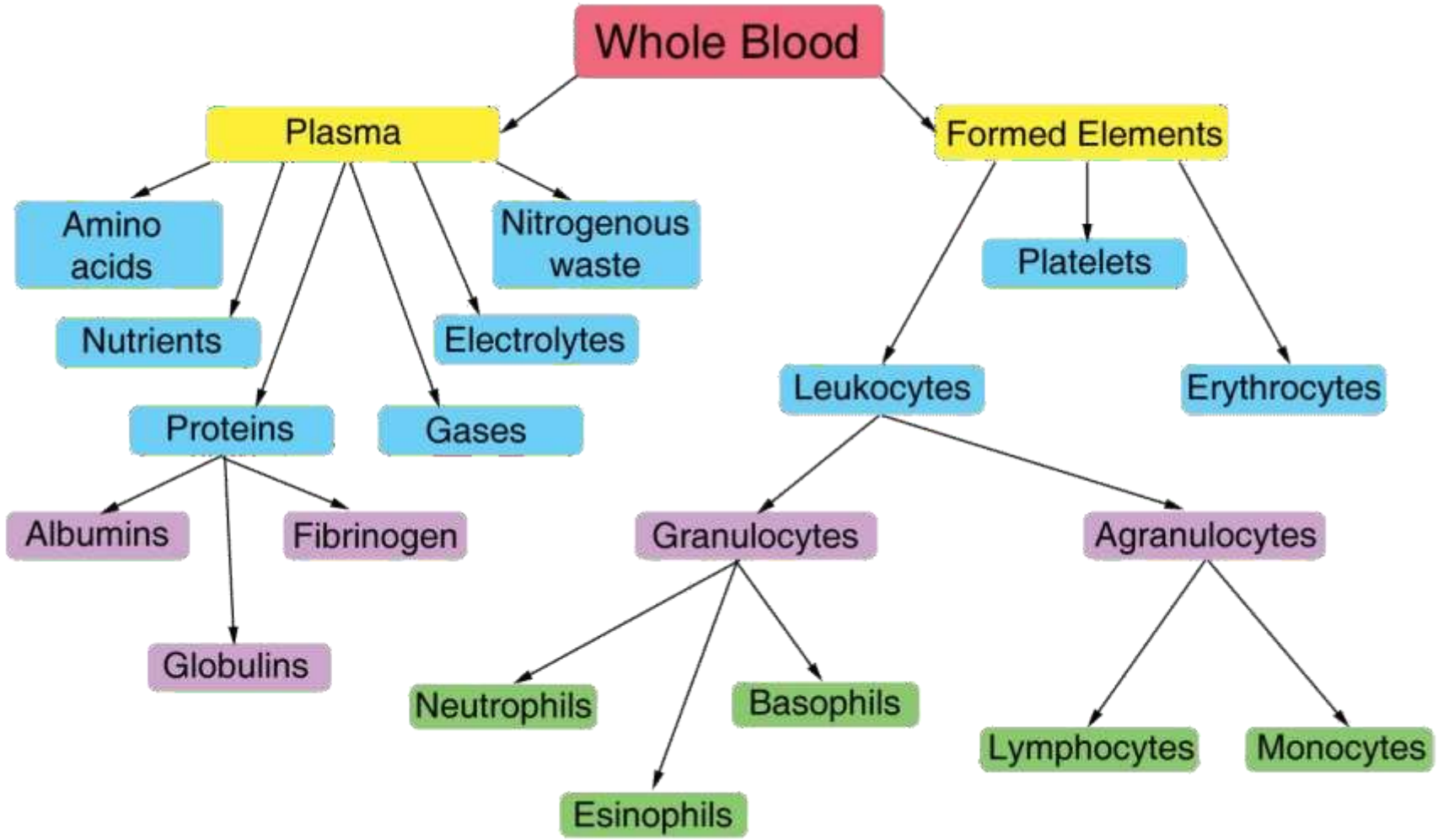
Blood constitutes huge amounts of different cells (specially RBCs) , and 55% fluid = plasma, you can note that sometimes when you draw blood (to know the amount of hemoglobin for example), the end of the tube contains gel, this gel is heparin, why we use it?

-When a blood sample is drawn, it naturally starts to coagulate, which can interfere with the accuracy of the test results. Heparin is an anticoagulant, meaning it prevents this clotting by inhibiting the action of certain clotting factors in the blood.

Sometimes we use empty tube when we do blood test to make the blood clot; therefore the RBCs go downward and the plasma floats.

Blood: plasma vs. cells

Don't memorize these things specifically



Plasma

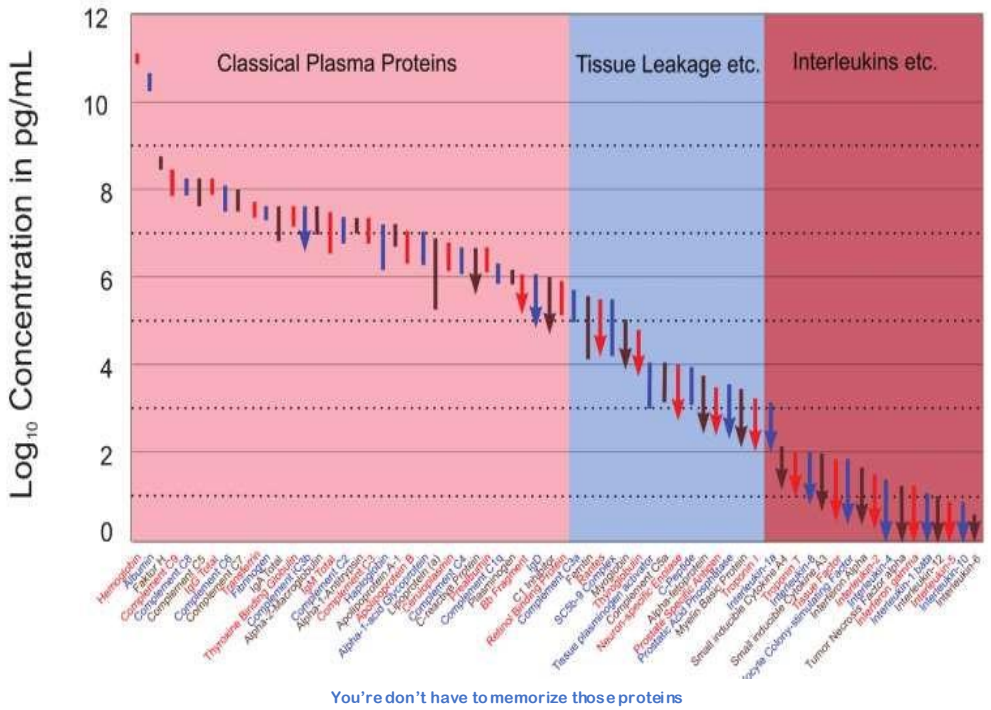
- It is the liquid medium in which blood cells are suspended.
- Composition: ▪ Water (92%) ▪ Solids (8%) everything except water
  - Organic:
    - Plasma proteins: Albumin, Globulins & Fibrinogen
    - Non-protein nitrogenous compounds: urea, free amino acids, uric acid, creatinine, creatine & NH3
    - Lipids: Cholesterol, TG, phospholipids, free fatty acids
    - Carbohydrates: Glucose, fructose, pentoses
    - Other substances as: Ketone bodies, bile pigments, vitamins, enzymes & hormones
  - Inorganic: Na+,K+,Ca2+,Mg2+,Cl-,HCO3-,HPO42-, SO42-

Don't memorize these things

Plasma proteins are a mixture

There is something called wide dynamic range, which means how much wide is the concentration of the protein.

- More than 500 plasma proteins have been identified.
- Normal range 6-8 g/dl (the major of the solids)
- Simple & conjugated proteins (glycoproteins & lipoproteins)

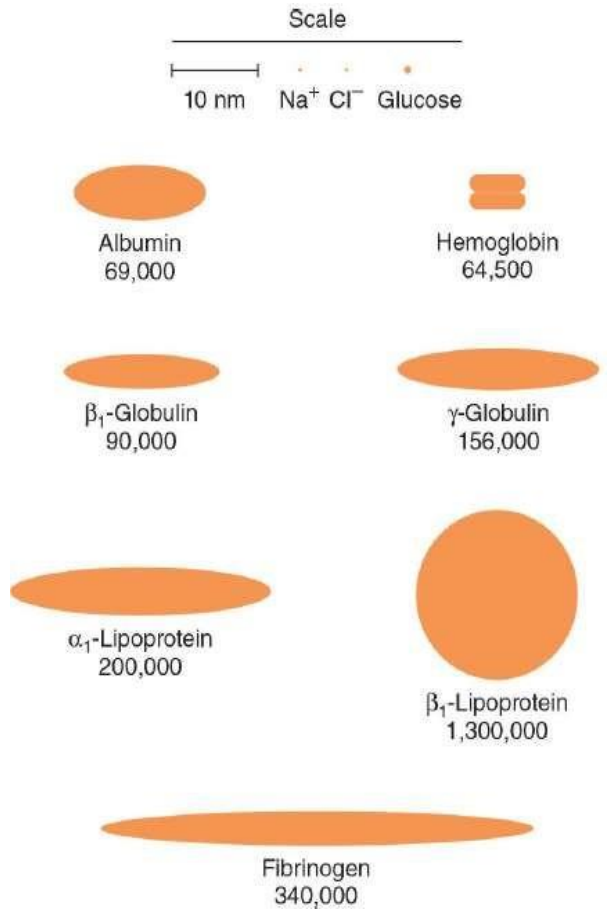


You're don't have to memorize those proteins

We have a huge amount of proteins in the blood as Albumin and Hemoglobin (including the proteins in the RBCs), but the major protein in the plasma is Albumin. There are other proteins in low concentrations.

1) For example, there are proteins we call "**interleukins**" or cytokines (inflammatory proteins that promote inflammation), which play a role in rising temperature, fighting pathogens, bacteria, viruses, and so on.

2) As well there are low concentrations proteins from tissue we called them "**tissues leakage proteins** " , how we get them ?- from the dead cells , When tissues are damaged(normal damage) or inflamed, they can become more permeable and renewal , allowing proteins and other substances that are normally contained within the cells to leak out into blood and kidneys and then we get ride from them out the body.



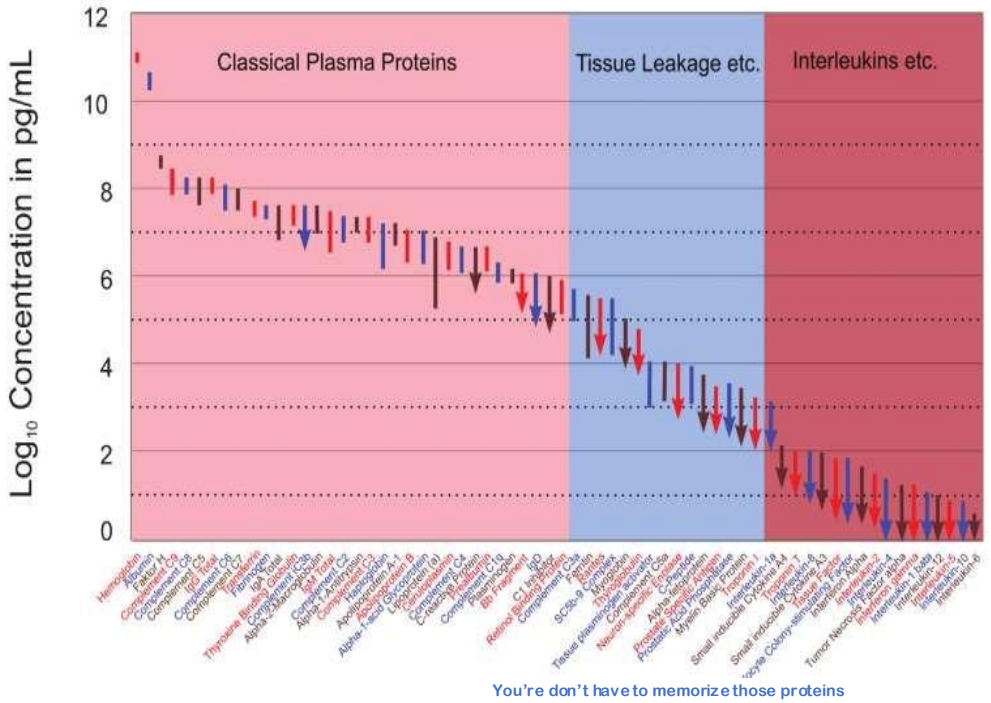
The concentration of these proteins will increase when…

when someone experiences a heart attack , skeletal muscle rupture, or liver damage (due to trauma or viral infection), the affected cells in these tissues die in large numbers. This cell death leads to the release of intracellular proteins and enzymes into the bloodstream so doctors can note that there is a damage in lever for example

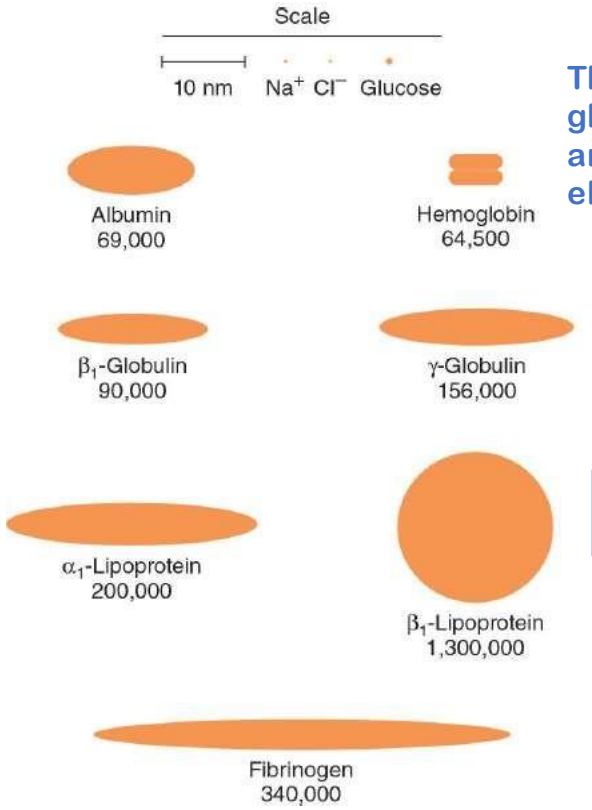
Plasma proteins are a mixture

- More than 500 plasma proteins have been identified.
- Normal range 6-8 g/dl (the major of the solids)
- Simple & conjugated proteins (glycoproteins & lipoproteins)

-Numbers are not required except for those mentioned in the next slides.



You're don't have to memorize those proteins



The size of the ions is very small and the size of glucose is slightly larger while proteins there sizes and shapes are different, for example **albumin** is elongated (Ellipsoidal) and the size of it is 69KDa.

Recall, the size and the shape fit with the function of proteins

Fibrinogen is indeed large (340KDa) and elongated protein, the elongated structure of fibrinogen allows it to efficiently form a network of fibers, which is essential for the clotting process.

TABLE 52—2 Majnr Funcõons of Blood

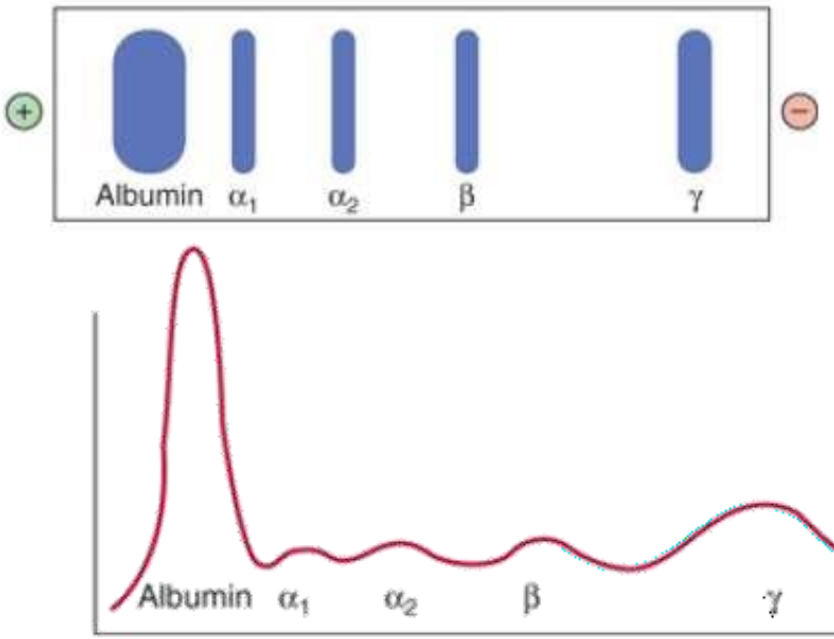
1. **Respiration**—transport of oxygen from the lungs to the tissues and of CO_2 from the tissues to the lungs
2. **Nutrition**—transport of absorbed food materials
3. **Excretion**—transport of metabolic waste to the kidneys, lungs, skin, and intestines for removal
4. Maintenance of the normal **acid–base balance** in the body
5. Regulation of **water balance** through the effects of blood on the exchange of water between the circulating fluid and the tissue fluid
6. Regulation of **body temperature** by the distribution of body heat
7. **Defense** against infection by the white blood cells and circulating antibodies **immunoglobulins, and antibodies.**
8. Transport of **hormones** and regulation of metabolism
9. Transport of **metabolites**
10. **Coagulation**

Don’t memorize this slide , just know there are serval functions depending on the type of proteins

The separation of plasma proteins

Phoresis= movement
Electro =electrical field
Chroma=color

- Electrophoresis (most common): serum (defebrinated plasma), five bands (albumin, α1 , α2 , β, and γ)



Chromatogram

NORMAL VALUES:

Name	Absolute values (g/l)	Relative values (%)
Albumins	35 – 55	50 – 60
α1-globulins	2 – 4	4.2 – 7.2 **5 %**
α2-globulins	5 – 9	6.8 – 12 **9 %**
β-globulins	6 – 11	9.3 – 15 **12 %**
γ-globulins	7 – 17	13 – 23 **18 %**

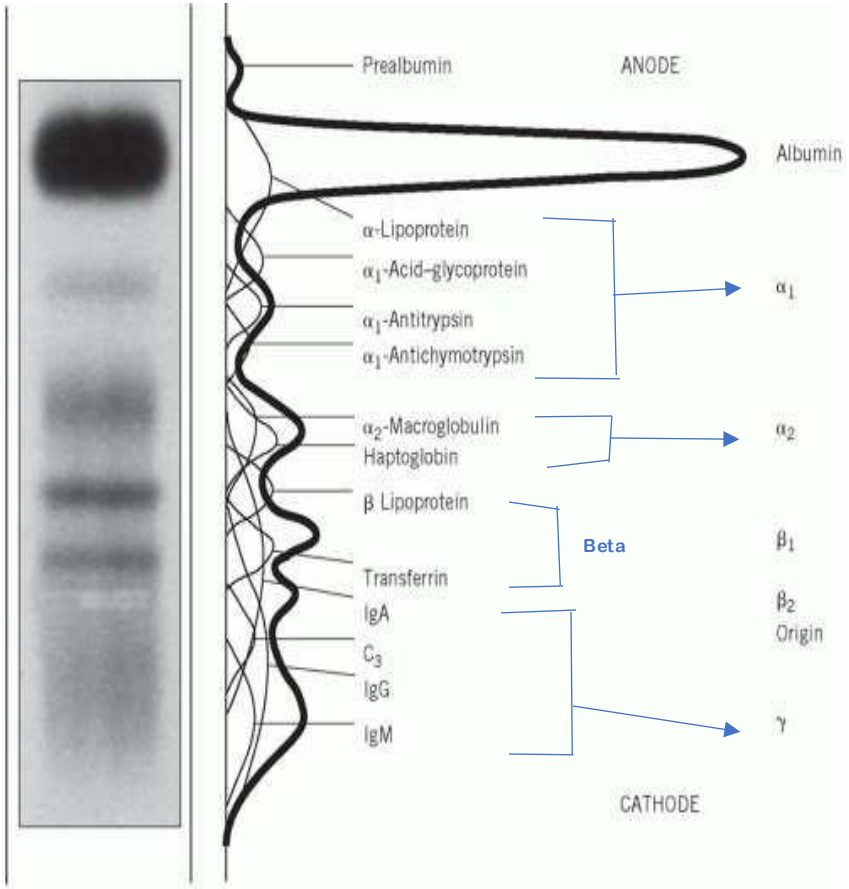
-Electrophoresis is a powerful technique used to separate high concentration proteins based on their size, charge (isoelectric point), or both. When we use this technique we will see five bands or clusters (albumin, α1 , α2 , β, and γ)

recall that we mentioned before (in mid material) there is something called isoelectric point of amino acid, also proteins have an isoelectric point (negative charges and positive charges equal to each other), because proteins have C terminus and N terminus and R group so we can say that this protein at physiological PH is negativity charged / neutral and so on...

Electrophoresis of plasma proteins

- Albumin is smaller than globulin, and slightly negatively charged
- Globulins (3 bands):
  - α band:
    - α1 region consists mostly of α1-antitrypsin

Hypoalbuminemia is a condition where albumin levels are low but still present.Analbuminemia is a genetic disorder resulting in the complete absence of albumin

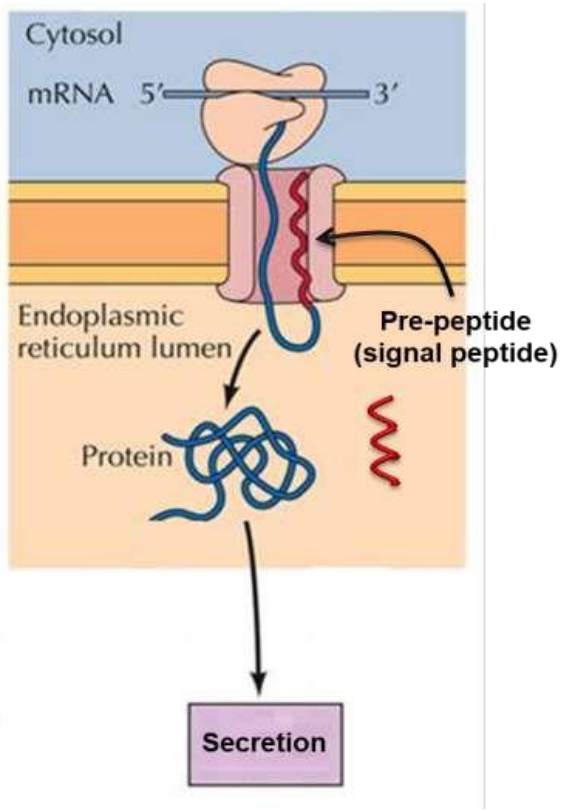


  - α2 region is mostly haptoglobin, α2-macroglobulin, & ceruloplasmin
- β band: transferrin, LDL, complement system proteins
- γ band: the immunoglobulins

Synthesis of plasma proteins

Recall, Gamma globulins, or immunoglobulins, are a class of proteins in the blood that function as antibodies, playing a crucial role in the immune system by identifying and neutralizing pathogens like bacteria and viruses, they are from B cells.

- Mostly liver (major source of proteins in plasma)(albumin, globulins), γ-globulins (plasma cells; lymph nodes, bone marrow, spleen).
- Most plasma proteins are synthesized as preproteins (signal peptide).
- Various posttranslational modifications (proteolysis, glycosylation, phosphorylation, etc.).
- Transit times (30 min to several hours).
- Most plasma proteins are glycoproteins (N- or O-linked).
  - Albumin is the major exception.



The signal peptide guides the newly synthesized protein to the ER or other cellular compartments, Inside the ER, the protein undergoes post-translational modifications before being transported to its final destination, for example by Glycosylation, then those proteins go to the golgi and then get released , (After the protein enters the ER, the signal peptide is typically cleaved off (بتتقطعbecause it did it's function)by a signal peptidase enzyme.

Glycosylation is a post-translational modification where carbohydrate molecules (glycans) are added to proteins or lipids.

Proteolysis is the biological process of breaking down proteins into smaller peptides or amino acids by enzymes called proteases (The duration of synthesizing proteases is variable)

Plasma Proteins & genetic variation

Genetic polymorphism

Poly = متعدد
morph= اشكال

Genetic polymorphism refers to the occurrence of two or more genetically distinct forms, or alleles, of a gene. Sometimes it does have a clinical significance.

- The follow a mendelian or monogenic trait.

  They exist in population in at least two phenotypes.

  - The ABO blood groups are the best-known examples

-Eye color is a classic example of genetic polymorphism, influenced by multiple genes that contribute to the diversity of eye colors in humans.

- Electrophoresis or isoelectric focusing is used for analysis.

Plasma Proteins Half-Lives

The "half-life" of a protein refers to the time it takes for half of the protein molecules in a cell or system to be degraded or eliminated.

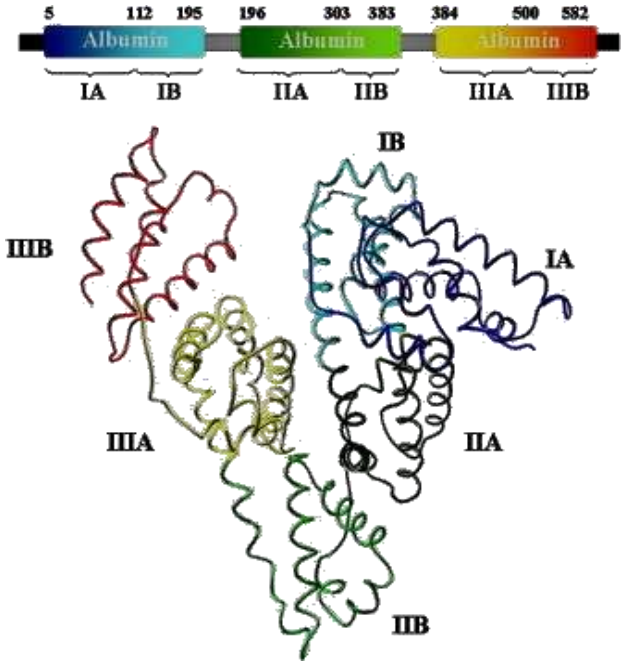
- Albumin & haptoglobin (20 & 5 days, respectively)
- Diseases can affect half-lives
  - In protein-losing gastroenteropathy such as Crohn's disease, albumin may be reduced (1 day).

Losing protein through the gastrointestinal tract refers to the loss of proteins from the body via the gut. This can happen in several medical conditions. For instance, inflammation in the colon can lead to diarrhea, which damages the colon tissue and results in the degradation and loss of proteins in huge amounts

Albumin

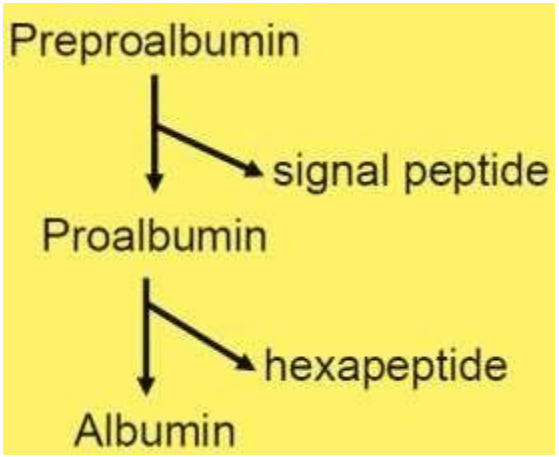
- The Major Protein in Human Plasma, 69 kDa, half-life (20 days)
- The main contributor to the osmotic pressure (75-80%)
- Liver: 12 g/day (25% of total protein synthesis) (liver function test)
- 3/5 total plasma proteins (3.4-4.7g/dL)
- Synthesized as a preproprotein
- Monomeric (made just of one polypeptide)
- Ellipsoidal shape (does not increase viscosity like fibrinogen)

- Anionic at pH 7.4 with 20 negative charges



-Osmotic pressure is crucial for maintaining fluid balance between the blood vessels and surrounding tissues, and albumin plays role in that, the concentration of albumin must be high (It helps retain water within the blood vessels by attracting and holding onto water molecules)

Pre= proteins are synthesized and enter the ER
Pro=cleaving or removing part of proteins (this is process of protein maturation), some proteins are synthesized as proproteins (inactive protein that need processing to do their function and get released)



Albumin is synthesized as preproalbumin , the pre region (signal peptide) is removed—pro region (hexapeptide) is removed —mature protein (albumin)

Albumin's binding capacity

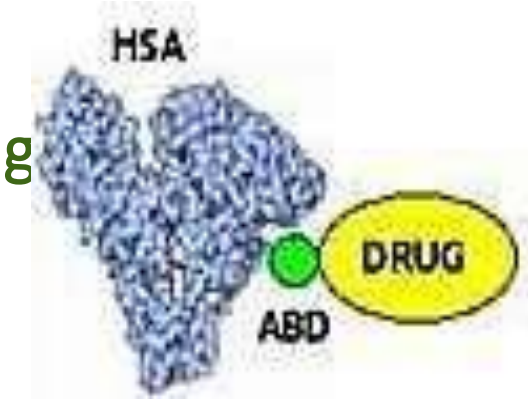
When muscles require energy (doing their metabolism) they signal adipocytes (fat cells) to release fatty acids, since fatty acids are hydrophobic, they cannot dissolve easily in the aqueous environment of the blood, to prevent them from clustering together and to facilitate their transport, albumin binds to these free fatty acids. It transports the bound fatty acids through the bloodstream to various tissues, including skeletal muscle.

Binds to these molecules nonspecifically

- binds various ligands:
  - Free fatty acids (FFA) Certain steroid, (steroid hormones(Androgens , estrogen, cortisol) are hydrophobic, they need carrier (albumin)
  - hormones Bilirubin
  - Plasma tryptophan
  - Metals: Calcium, copper and heavy metals
  - Drugs: sulfonamides, penicillin G, dicumarol, aspirin (drug-drug

Bilirubin is a product that is produced during the normal breakdown of red blood cells. It is a byproduct of the degradation of heme (hydrophobic and toxic), a component of hemoglobin in red blood cells. So albumin carry the heme to prevent it from clustering and entering the CNS which damages it.

Hydrophobic

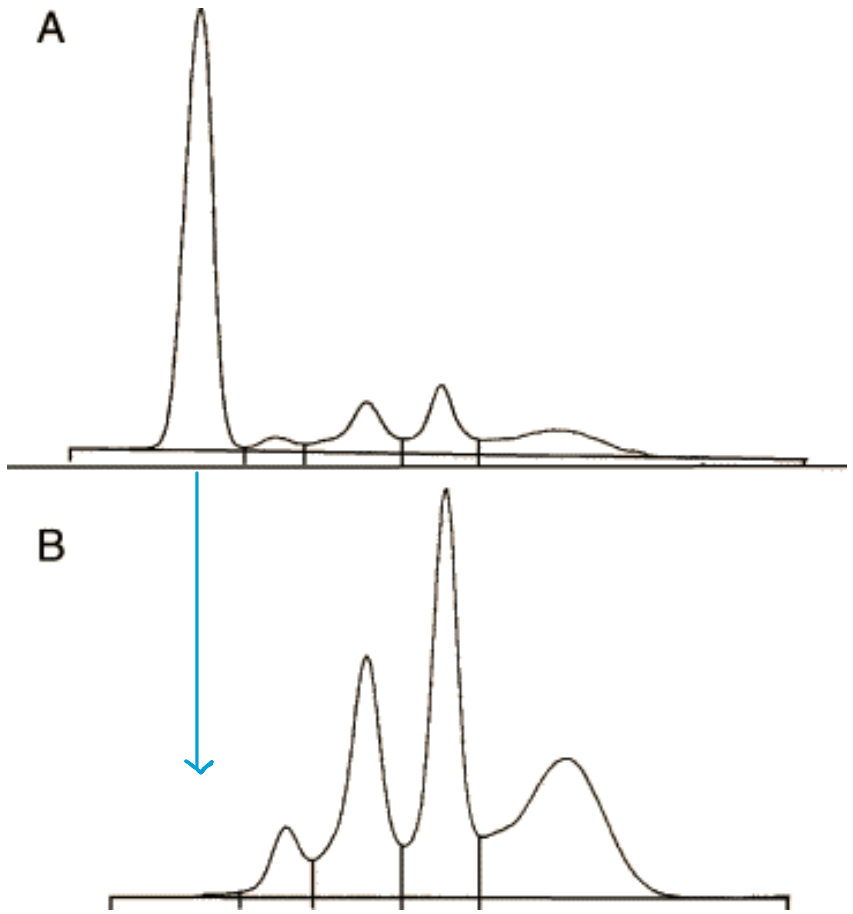


Analbuminemia

Analbuminemia is a rare genetic disorder characterized by the absence or extremely low levels of albumin in the blood.

- There are human cases of analbuminemia (rare)
- Patients show moderate edema!!!

Albumin is the most abundant protein in the blood plasma, playing crucial roles in maintaining osmotic pressure, so if we don't have albumin the blood will be very fluidic and a lot of water will go into the tissues (due to a large amount of water compared to the protein) but edema doesn't take place , because body compensate by producing more of the other proteins, **"moderate edema"** refers to a noticeable but not severe accumulation of fluid in the tissues, causing swelling. In the context of analbuminemia, moderate edema occurs because of the lack of albumin.



Other clinical disorders

Hypoalbiminemia: edema seen in conditions where albumin level in blood is less than 2 g/dl

- Malnutrition (generalized edema)
- Gastrointestinal loss of proteins

Analbuminemia is a genetic disorder resulting in the complete absence of albumin, The body may compensate by increasing the production of other plasma proteins, which helps to partially maintain oncotic pressure and thus mitigates the severity of edema "moderate edema ".
Hypoalbuminemia is a condition where albumin levels are low but still present, here cells and tissue can't compensate due to the presence of albumin. Albumin presence results in feedback inhibition (even it was in little amounts). So, severe edema is a result of Hypoalbuminemia.

Hyperalbuminemia: dehydration (relative increase)

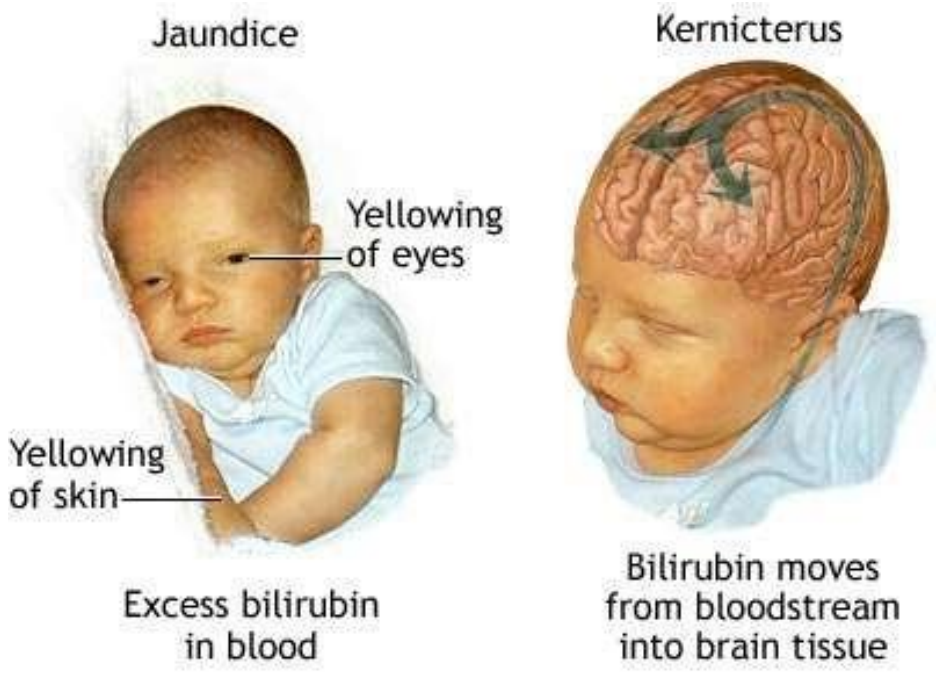
Other clinical disorders

Albumin can bind to molecules nonspecifically, molecules can include certain drugs. Any drug taken, first it gets processed & modified by liver cells ,then it becomes inactive and exits the body. Some exits to the blood, then some of these drugs in blood bind to Albumin, so the drug becomes inactive since it is not free. However, some of this drug remains active if not bound.

- Drug-drug interaction:
  - Bilirubin toxicity (aspirin is a competitive ligand): kernicterus and mental retardation
  - Phenytoin-dicoumarol interaction (epilepsy vs. anti-coagulant, respectively))

Phenytoin and dicoumarol should not be taken together. Phenytoin treats epilepsy, while dicoumarol is an anti-coagulant. Both bind to Albumin at the same place, so if taken together, they will compete on who binds to Albumin. Thus, the levels of these two drugs will be high in blood and they can cause severe side effects.

In some cases like Bilirubin toxicity, mostly occurs in children when they take aspirin. Aspirin will inhibit bilirubin to bind to Albumin. So bilirubin will be free in huge amounts, thus entering the CNS and damaging it. It will cause children to suffer from mental retardation.

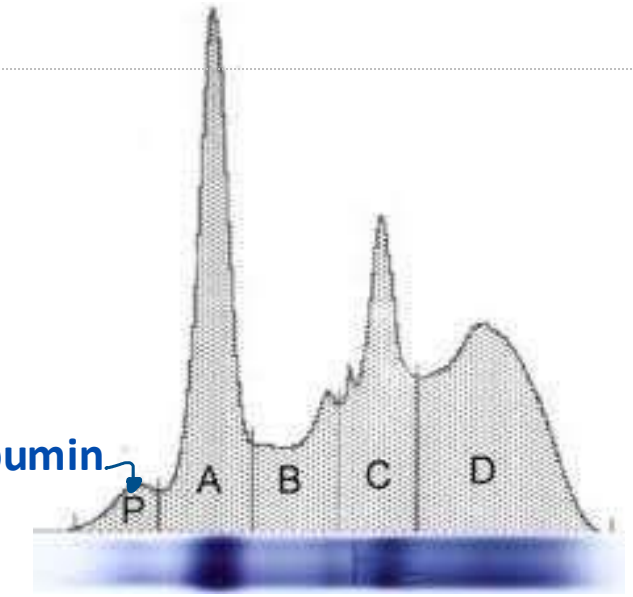


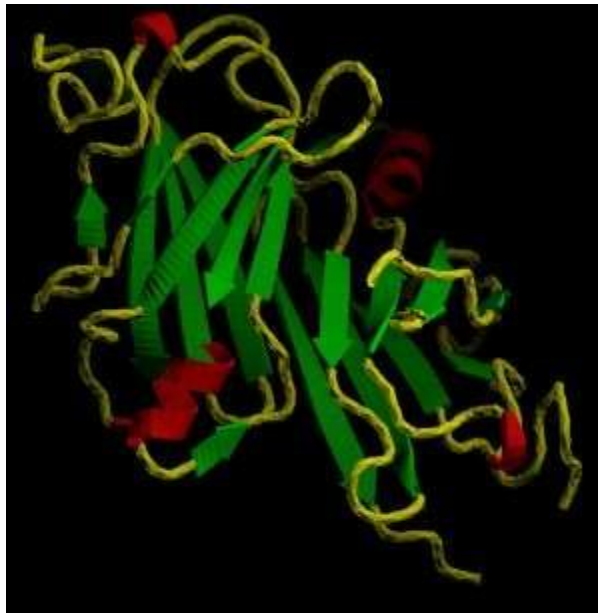
«سَبيلُ العُلا عَالٍ علىٰ مَن تَعَللا
ومَن جَدّ في سَعيٍ لأمرٍ تَمَكنا»

Prealbumin will not give albumin, pre here indicates to the location (it's saperation) in chromatogram , pre = coming before albumin.

Prealbumin (transthyretin)

- It exists as a 62-kDa glycoprotein.
- It has short half-life (≈2 days).
- It is a sensitive indicator of poor protein nutrition.
- Main function: carrier of thyroid Hormones (T3, T4)
  - T4 (Thyroxine) and T3 carrier





سبحان الله
والحمد لله
ولا اله الا الله
والله اكبر

Acute-phase proteins

- Plasma proteins whose Levels increase (up to 1000 folds), acute inflammation, tissue damage, chronic inflammation & cancer.
- C-reactive protein (CRP), α1 -antitrypsin, haptoglobin, & fibrinogen
- Interleukin-1 (IL-1) is the main stimulator

Examples of these proteins

stimulates the releasing of Acute phase proteins.

Inflammation (presence of pathogens) leads to: the body increase the concentration of these proteins to protect the body.
For example, if someone has a fever this will make the blood test, which shows the acute phase proteins, be of high level so he has systemic inflammation (inflammation in the whole body).
This is a result of having viruses/bacteria…

قالﷺ: "أولى الناس بي يوم القيامة أَكثرُهم عليَّ صلاةً"

Purpose of acute of phase proteins

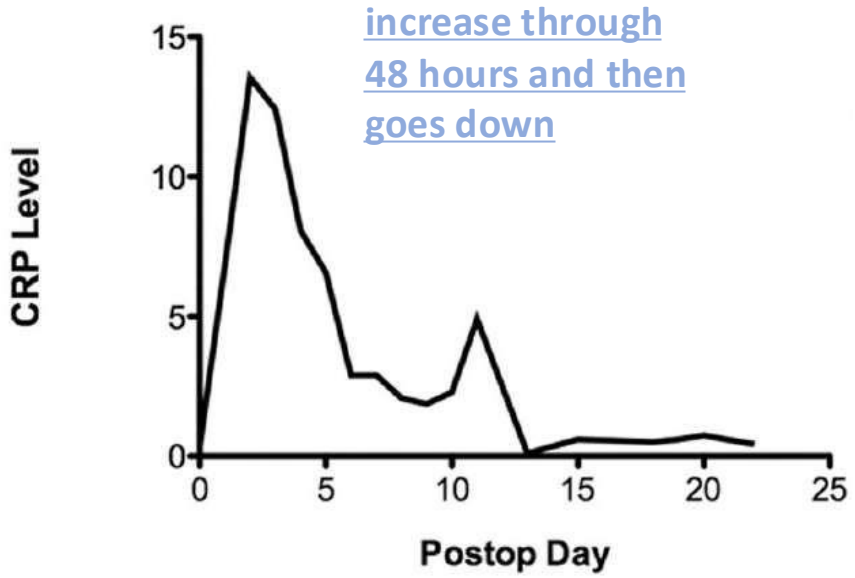
Will be explained in the next slides.

Protein	Function
C-reactive protein	Stimulates the complement pathway
α1-antitrypsin	neutralizes certain proteases released during acute inflammation
Fibrinogen	Coagulation factor
Transferrin	Iron binding (preventing microbe uptake of iron)
Haptoglobin	Hemoglobin binding (iron protection)
Ceruloplasmin	Iron oxidation (iron binding by ferritin)

C-reactive protein (CRP)

CRP binds on the surface of the cell wall of bacteria called (pneumococci).

- It is able to bind to a polysaccharide called fraction C in the cell wall of a bacterial species called pneumococci.
- It is undetectable in healthy individuals.
- It helps in the defense against bacteria and foreign substances.
- It is detectable in many inflammatory diseases (Acute rheumatic fever, bacterial infection, gout, etc.) & Tissue damage
- Its level reaches a peak after 48 hours of incident (monitoring marker).



The body knows that if there is inflammation (caused by this bacteria) the body increases releasing of CRP level.

Globulins

α1-globulins	α2- globulins	β- globulins	γ-globulins
▪α1-antitrypsin ▪α1-fetoprotein ▪α1- acid glycoprotein ▪Retinol binding protein	▪Ceruloplasmin ▪Haptoglobin ▪α2-macroglobulin	▪CRP ▪Transferrin ▪Hemopexin ▪β2-microglobulin	▪IgG ▪IgA ▪IgM ▪IgD ▪IgE

Found in alpha1 (the band coming after albumen)

α1-antitrypsin

proteinase = enzyme that break protein

Usually , your body releases these enzymes which degrade the proteins in tissue (causing tissue damage). When cell release proteinase, it releases antiproteinase with them to maintain and control the balance. Example on antiproteinase: antitrypsin .

- Also known as (AKA) α1-antiproteinase (52 kDa)
- It neutralizes the trypsin & trypsin-like enzymes (such as elastase).
- 90% of α1- globulin band
- Polymorphic (75) إله عدة أشكال ؛ Like eye color.
  - Alleles Pi^M, Pi^S, Pi^Z, Pi^F (MM is the most common)
- Deficiency (genetic): **Emphysema** is found in people with ZZ or SZ. Bulge in lungs ---> tissue damage
  - MS and MZ usually not affected
- It is ncreased level of α1- antitrypsin (acute phase response)

What is MM? Our cells are diploid (2n , 2 chromosomes you get, a chromosome from your mother (which indicates to M protein) and one from your father (also M).

Since Z is not really active in stopping the trypsin (proteinase).

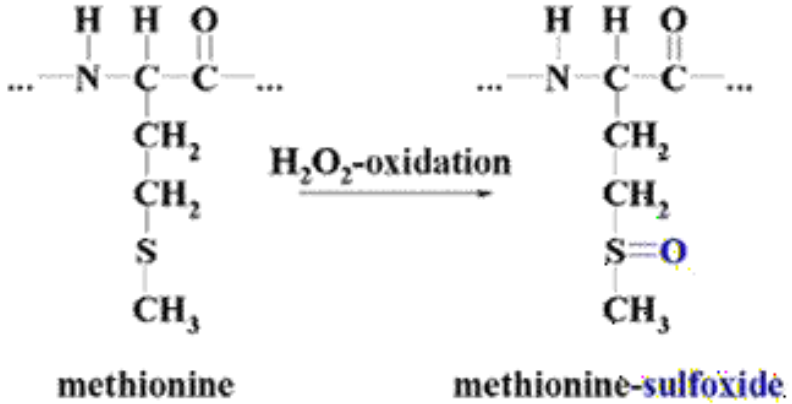
Active elastase + α_1–AT → Inactive elastase: α_1–AT complex → No proteolysis of lung → No tissue damage

Active elastase + ↓ or no α_1–AT → Active elastase → Proteolysis of lung → Tissue damage

اذا ما فهمتوا هاد السلايد قدموا سلايدين في شرح اله ^_^

Smoking & α1- antitrypsin deficiency

modification (oxidation) for met that exists in antitrypsin, as a result it will not work efficiently.

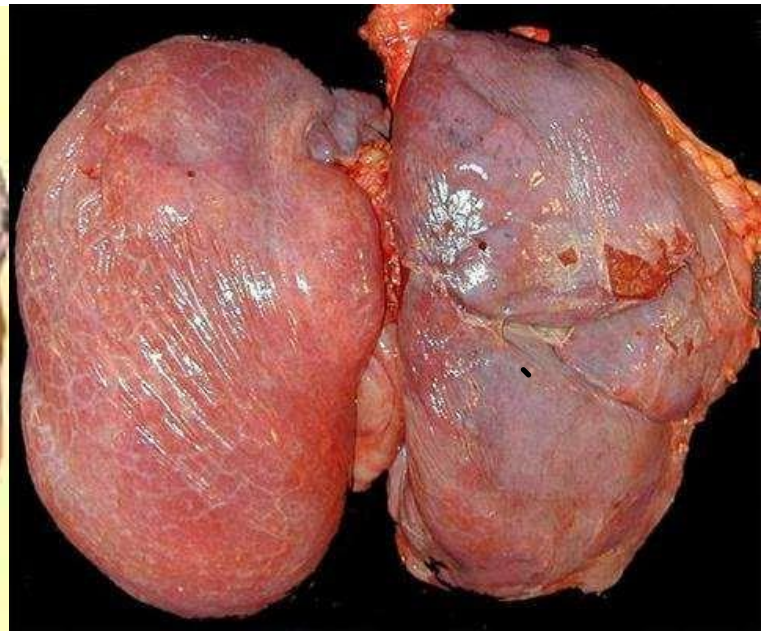


Chronic inflammation

Oxidation of Met358

devastating in patients

ZZ type + smoker = 😱😱



So smokers have higher ability to have emphysema.

يقول الله عز وجل : (سَنُرِيهِمْ آيَاتِنَا فِي الْآفَاقِ وَفِي أَنْفُسِهِمْ حَتَّى يَتَبَيَّنَ لَهُمْ أَنَّهُ الْحَقُّ)

تجميع أفكار للسلايدين الي قبل :)

Acute phase protein → trying to protect your body against inflammation.

Example of these proteins : alpha 1 Anti trypsin

Anti: trying to inhibit trypsin (control protein degradation) بحاول يثبط الإنزيم الي بكسر

Trypsin : enzyme breaks proteins

لازم يكون في توازن بين الإنزيمين

There are many types of antitrypsin → M, S , Z ,F

What is the difference between them ؟
They differ in how good they are in inhibiting trypsin. (بختلفوا بالكفاءة)
M → most effective.
Z → less effective =not effective

إذا عندك جين أعطاك M وكمان جين أعطاك M بطلع النوع الي عندك MM.

الـ trypsin ماشي و عم بكسر عن جنب و طرف مافي اشي يوقفه (لأنه ال Z ضعيف جدا ما عنده قدره يثبط الإنزيم)
لذلك ال Trypsin رح يدمر النسيج بالرئة و تصير الرئة نافخة emphysema

طيب في ناس عندهم جينين أعطوا ZZ شو بصير عندهم ؟

بالوضح الطبيعي بكون عنا الأنزيمات المضادة مثل Antitrypsin لكن بزيد بحالة الـ inflamation

SOS SOS SOS

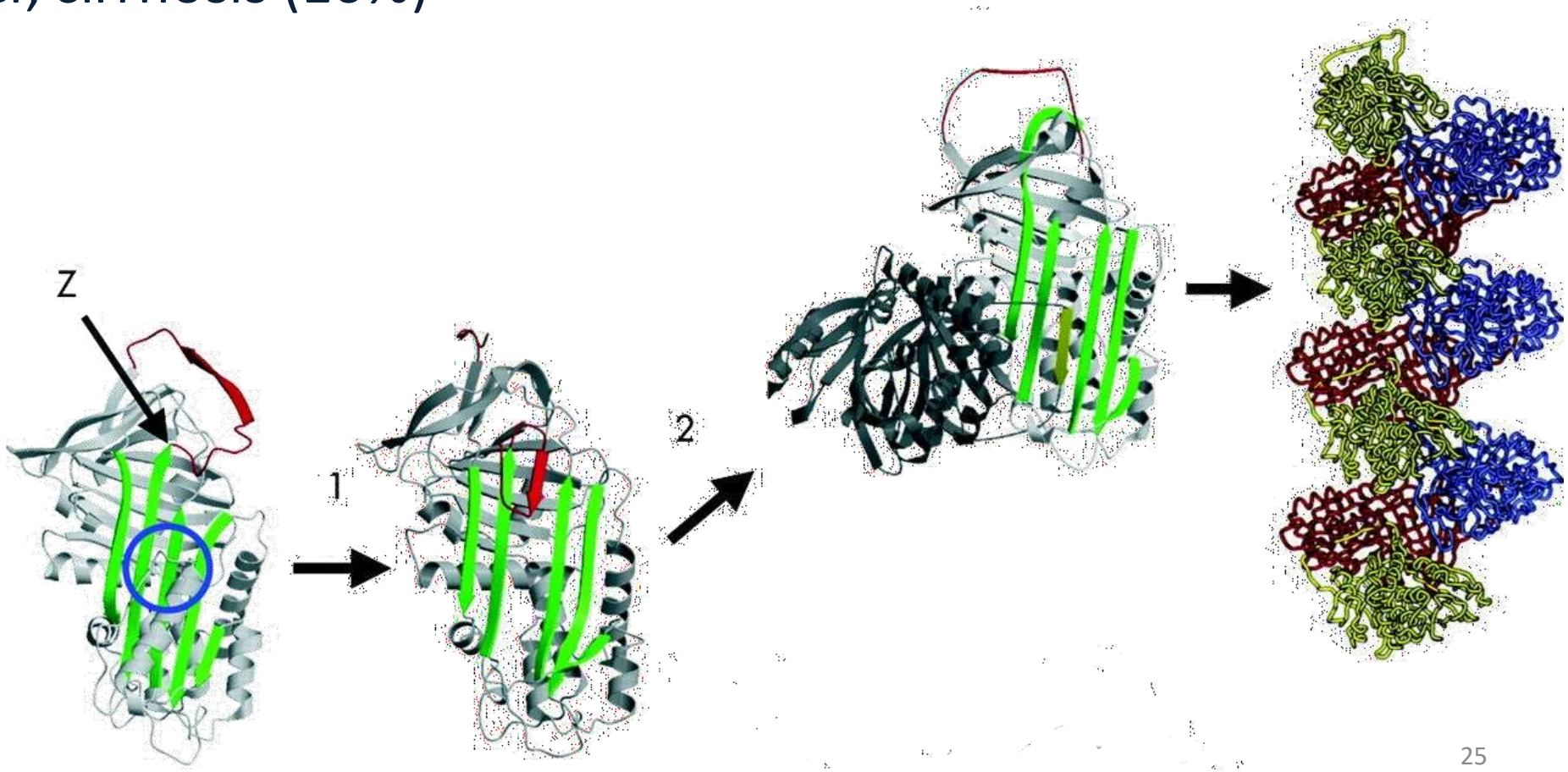
في مشكلة عند المدخنين إنه رح يصير أكسدة للحمض الاميني Met الموجود بال Antitrypsin.
نتيجة الأكسدة رح يبطل الإنزيم شغال و رح يعمل emphysema للمدخنين...
الحل :تترك التدخين لأنه it's not a joke

Liver disease & α1- antitrypsin deficiency

liver damage

Cirrhosis can be caused by ZZ

Liver disease: ZZ phenotype polymerization (loop with β-sheet), aggregates in liver, cirrhosis (10%)



Hemoglobin exist in RBC, when RBC die hemoglobin will be released.

Haptoglobin (Hp)

Recovery of hemoglobin should occur for two reasons:
1) Heme converted to bilirubin and bilirubin is toxic.
2) The most important thing in Heme is iron. Millions of RBCs will be damaged which means millions of iron will be lost. We have to compensate this iron, we need it! لازم نرجع نسحبه

Haptoglobin bind to Hemoglobin to maintain it (preventing filtration).

- It is an acute phase protein.
- α2 glycoprotein (90kDa)
- A tetramer (2α, 2β) + Polymorphic
- Two genes, designated Hp1 and Hp23, producing phenotypes:
  - **Hp 1-1→ α1, α1 + 2β**
  - **Hp 2-1→ α1, α2 + 2β**
  - **Hp 2-2 → α2, α2 + 2β**

Haptoglobin is synthesized by our bodies to maintain hemoglobin. It exists in certain percentage. A lot of RBCs will be degraded→Hemolysis means the release large amounts of hemoglobin. So part of haptoglobin percentage will bind to hemoglobin. Then those haptoglobins will be damaged. If we lost large amounts of RBC = larger percentage of haptoglobin will bind and larger amounts of haptoglobin will be lost.

- Binds the free hemoglobin (65 kDa); prevents loss of hemoglobin & its iron into urine
- Hb-Hp complex has shorter half-life (90 min) than that of Hp (5 days)
- Decreased level in hemolytic anemia

People with hemolytic anemia have a low level of haptoglobin

Lysis of RBC نقص حديد ، فقر دم

https://youtu.be/KCh-7Ghj0jY?si=9omMkr-6F6Y7VTMR

Watch this , may be helpful

Ceruloplasmin

- Amine oxidase
- Copper-dependent superoxide dismutase
- Cytochrome oxidase
- Tyrosinase

Protein which is binding to copper

The problem of copper and iron →both of them are toxic.

(make oxidation/ tissue damage>>> should be free for being toxic.

- A copper-containing glycoprotein (160 kDa)
  - It contains 6 atoms of copper
- Metallothioneins (regulate tissue level of Cu)
- It regulates copper level: contains 90% of serum Cu.
- A ferroxidase: oxidizes ferrous to ferric

Having Enzyme activity

  - Important for transferrin binding
- Albumin (10%) is more important in transport

Ceruloplasmin + albumin are copper carrying proteins. However, albumin is more important in binding and transporting copper.

أنتم حملة الراية ، والراية لا تحملها يد ضعيفة...

Pathological conditions related to ceruloplasmin

- Ceruloplasmin deficiency can arise from genetic causes or lack of dietary copper.

Low amount

- **Hypo**ceruloplasmenia
  - Ceruloplasmin levels are ~50% of normal
  - No clinical abnormalities
- Aceruloplasminemia
  - No ferroxidase activity of ceruloplasmin
  - If left untreated, accumulation of iron in tissues and organ failure
- Wilson's disease

Depending on transporting of copper not ceruloplasmin

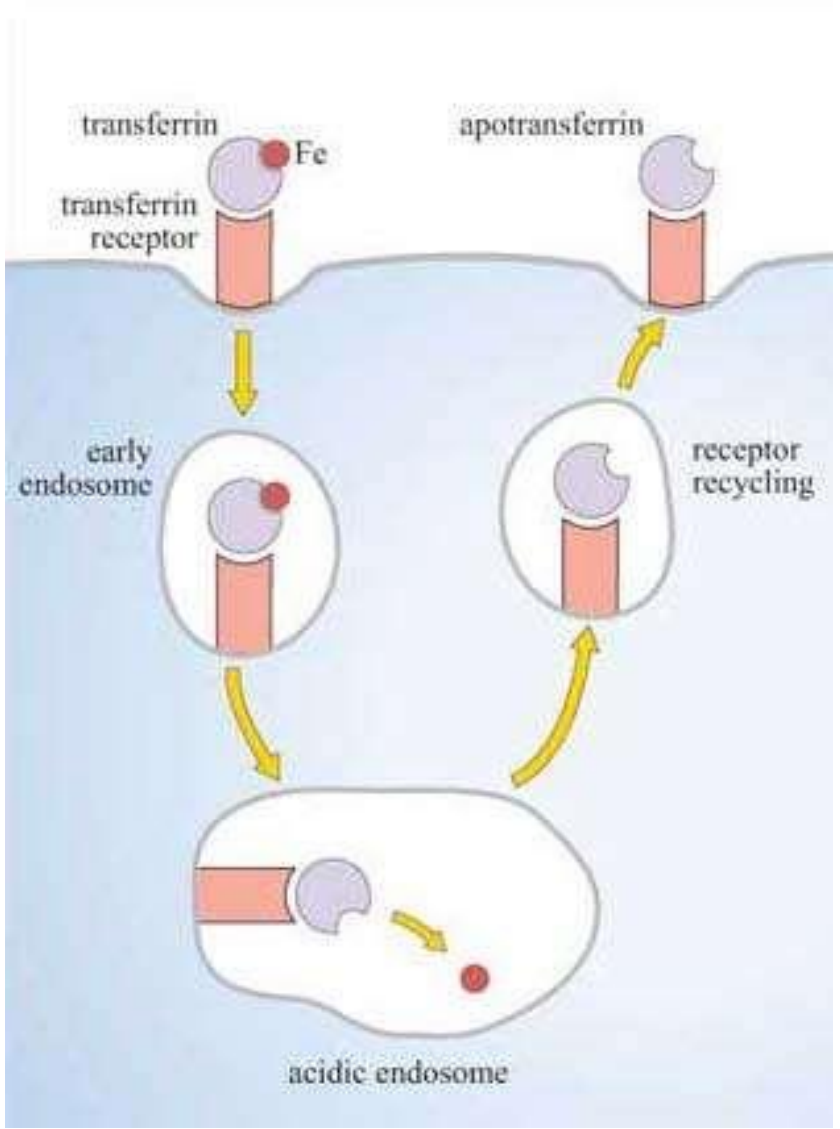
  - Defective transporter (copper-binding P-type ATPase or ATP7B protein) leading to excess liver copper, increased apoceruloplasmin, and copper toxicosis.

Transferrin

Transfer + ferrin = iron transport

- A β1-globulin that functions as iron transporter
- A glycoprotein synthesized by the liver.

You only have to know that this protein transfers iron.



Alpha-2 macroglobulin

- It is a large plasma protein.
- It is responsible for the transport of 10% of zinc and cytokines in blood.
- α2-macroglobulin binds to and inactivates diverse type of proteases.
  - Blood coagulation

Protein degradation

«يا نُخبة الجيل يا مَن أنتمُ أملٌ
طالَ الظّلامُ فنرجو منكم الفجرا»

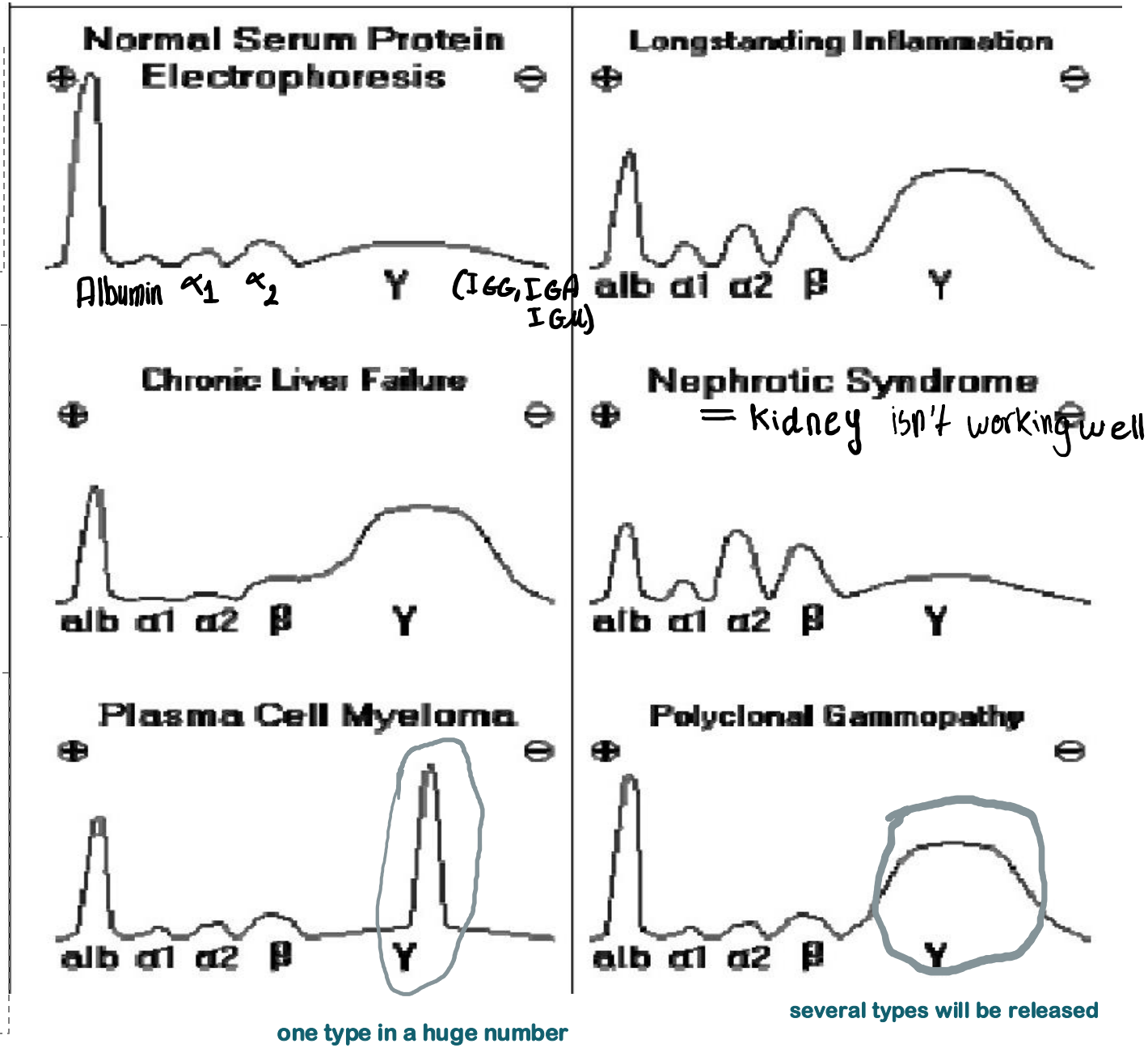
صنعكم اللهُ لميادينَ تُرضيه عنكم

Very important(memorize the chromatogram and the condition).

All of them are peaks, except gamma band, because of large quantities and different sizes.

Can't synthesize albumin + alpha one + alpha 2 -> All will be of low level compared with gamma, which relatively looks high.

Maturation of B cells and they make and release one antibody, they become plasma cells. These plasma cells could be cancerous, when it becomes cancerous it will release one type of antibody ->> increase in number of cells and increase in antibody number. This peak look sharp because only one antibody level will increase in blood.



one type in a huge number

several types will be released

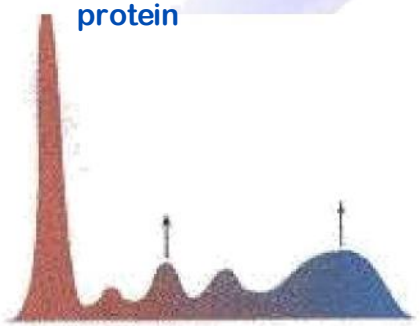
Acute phase proteins level + immunoglobulin (different types) will be high -> inflammation all the time.

Kidney will make filtration so proteins is lost in urine since renal tissue is damaged -» loosing albumin.
Alpha 2 represents a macro-globulin (large proteins that can't be lost, only small ones get lost).

Different types of B cells will be damaged, so It will synthesize different types of immunoglobulins (IGA, IGG, IGM) so the peak looks wide and big. Here different types of immunoglobulins are being released, that's why it looks wide.

☺ وأخيرااا يعطيكم العافية

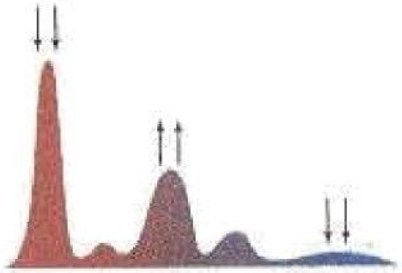
increase in immunoglobulin
Increase in acute phase protein



Delayed 'immune' Response Pattern

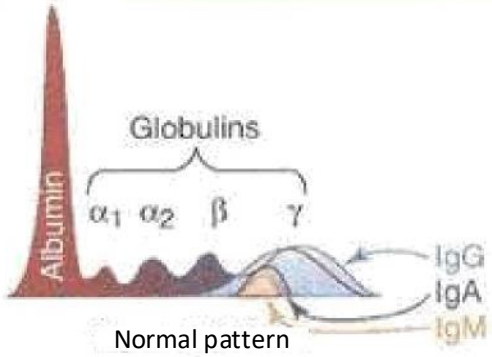
c

Increase alpha 2 (macro-globulin)



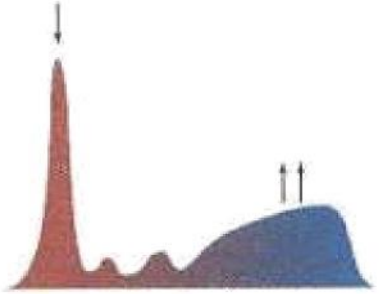
Nephrotic Syndrome

g



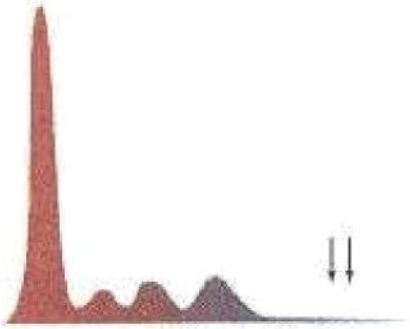
Normal pattern

(a)



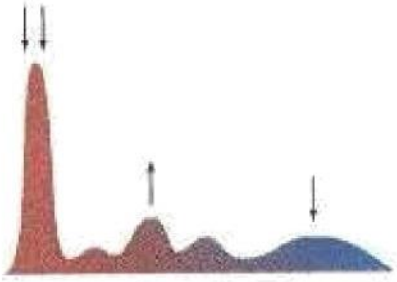
Hepatic Cirrhosis
("Polyclonal Gammopathy")

(e)



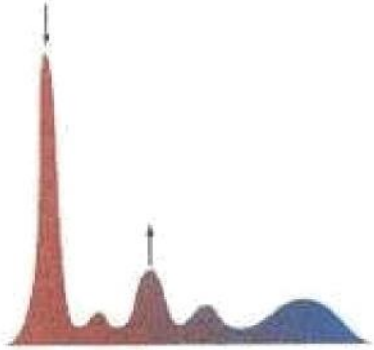
Hypogammaglobulinemia

d



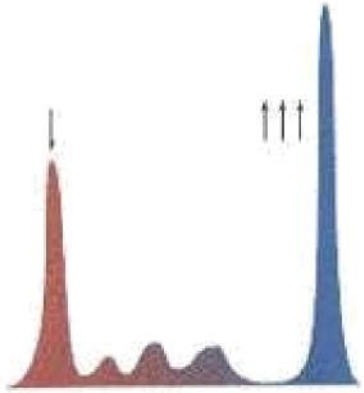
Protein-losing Enteropathy

h



Immediate response pattern

b



Paraprotein
("Monoclonal Gammopathy")

(f)

Hypo = deficiency in immunoglobulin
No gamma peak ->> no production of immunoglobulin

Decreased albumin
Increased alpha 2 (macroglobulin)
(alpha one + beta) will relatively decrease

here only monoclonal->one type

For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V1 → V2	Slide 15 Slide 28 Slide 27	**Albuminemia**	**Analbuminemia** **Change the position of blue sentence** **Link is added**
V2 → V3			

Additional Resources Used:

1. Book pages
2. YouTube videos
3. Webpages
4. Anything else…

رسالة من الفريق العلمي:

تم الاعتداء بكل وحشية على أبنرى فلـوطينيين , تم استئصال طحال وكبد أبنير فلـوطيني -من ذوي الاحتياجات الخاصة !- وأُصيب بالعمى من أثر التعذيب..وتم تسليمه بعد ذلك لأحد مستشفيات عْرْة من قبل قوات الاحتلـال ليستشـهـ ـد بعدها بأربعة أيام إثر الجـ ـرائم التي ارتكبها الاحتلـال بحقه ! الاحتلـال يقوم بالعمليات الجراحية غالبا بدون تخدير، بهدف تعذيب الأبنير !هذا كله جزء ضئيل مما يتعرض له أهلنا في عْرْة

اللهم إنهم قد طغوا في البلاد وأكثروا فيها الفبناد.. فصُبَّ عليهم يا ربنا غضبك صبًّا وأهلكهم واجعل كيدهم في نحورهم يا ربنا ومولانا ومُعيننا أنت المُعز وأنت المُذِل سُبحانك حرك جند السماء و ثبت عبادك.

ادعوا لكل من شارك في كتابة هذا الموديفايد براحة البال وصفاء الذهن "اللهم هوّن ثم هوّن ثم هوّن ثم أرح نفساً لا يعلم بحالها إلا أنت "