The Blood



-Blood is a specialized connective tissue in which cells are suspended in a Fluid ECM called **plasma**

***Blood transfer in hospitals :-***

In jordan the blood bags where given for free to pateints that are in need but nowadays it's given for a very cheap price

-the blood bags that contains blood contains anticoagulant factors like Aspirin to prevent blood from coagulation .

-Any new Disease that occur in our society will be tested if it can transfer to patients by blood to assure safety in blood donation .

-The blood is tested for many things before given it to the patient like :1- The hemoglobin content to make sure that the patient will get the amount of oxygen he needs

2-The blood is tested for the amount of RBC'S , White blood cells . platelets it contains

3- the blood will be tested for HIV or Aids because it's widely distributed .

-the lifespan of an RBC outside the body (in blood bags ) is about 20 days while the RBC lifespan in the body circulation is about 120 days so as doctors we try as much as we can to give the patients freash blood Because when the blood sample age is longer the less it's capicity to carry O2 in the patient's body .

***The formation of blood during embryonic life :-***

The blood is a connective tissue so it's mesodermal in origin, the mesenchymal tissue in day 20 aggregated to form the mesoderm the lateral aspect of the mesoderm was stimulated to form Endothelium and the cells inside became stem cells for the formation of blood and then they started to migrate in all directions until the fetus formation was complete .

\*the first organ in the body that started to synthesize RBC'S is the **Spleen** and then the liver and then the bone marrow when the bone was formed from Hyaline cartalige

***The characteristics of blood in our circulation :-***

-the amount of blood circulating in our body is 5L and you have to remember that the circulation in our body is a closed circulation so when there is an excessive loss of blood ,this loss must be compensated for by blood donation because the process of forming blood and it's components is relatively slow

For example :- if a patient had a fracture in the femur , he will bleed about 1.5 L of blood and it's must be compensated for , when that patient come to the hospital you must give him a lot of normal saline just to maintain the action of the heart because when a lot of blood was lost and the venous retain decrease the heart will be affected , but the reason that you need the blood donation is that these normal salines will be lost from the body rapidly so you must give that patient blood.

\*in excessive bleeding cases the bone marrow will be stimulated to make more blood cells (Hemopoiesis) but this process takes time so the bone marrow will be forced to push the immature RBC'S Into the circulation this compensate for the volume but it doesn’t compensate for the function .

***The components of the blood :-***

The blood is composed of formed elements and the plasma which is the ground subtance

The formed elements are :- 1-Erythrocytes (red blood cells )

2- Leukocytes (white blood cells )

3- Thrombocytes (platelets )

**The plasma :-** it's an aqueous solution with 7.4 PH mostly composed of water with a 92% and 7% proteins and 0.9 % of other subtances like Electrolyte ions ,Nutrients ,waste products and respirotary gases

The proteins of the plasma :

1-Albumin : it's the most abundant plasma protein responsible to maintain the osmotic pressure of the blood which is important for reabsorbtion it's made in the liver

-the patients that suffer from decrease of albumine in blood (hypoalbuminia ) will suffer from **edema**

2-Immunoglobulin :- our immunity system depends on it ,immunoglobulines are antibodies produced by plasma cells in many location

3-Fibrinogen :-the largest plasma protein made in the liver it's important for blood clotting during bleeding .

\*the inorganic salts in the plasma makes about 0.9% and any solution with an osmolarity of 0.9 % is described as an isotonic solution (normal saline )

\* in cases of generalized edema we give the patient a hypertonic solution (more the 0.9 %) to absorb these fluids into the blood stream and get rid of it



**Erythrocytes :-** blood cells that lack a nuceli and it's completely filled with the O2 carring protein hemoglobin and they are the only blood cells that their function doesn't require them to leave the vasculature .

The shape of the Erythrocytes is a biconcaved disk with central invagination and the periphery is swollen this configuration helps to increase the surface area of the Erythrocytes compare to it's volume and facilitate gas exchange .

\*the Erythrocytes is 7.5 Mm in a diameter and it's 2.6 Mm thick at the rim but only 0.75 Mm thick in the center , the number of Erythrocytes in male is about 4-6 million and in women about 3.9-5.5 million and the reason that women RBC'S are less than men is because of the hurmonal effect in menstrual cycle in which female constantly lose blood every month .

\*in cases where the number of RBC'S is less than 4 million it is **Anemia** and when the number of RBC'S is more the 6 million it's **Polycythemia**

\*sometimes the increase in number of RBC'S is physiological like in individuals who live in high altitude where O2 Tension is low the bone marrow will make more RBC'S , another example : in new borns if you take a blood sample from a new born the number of RBC'S is approximately 8 million because during embryonic life he was living under low oxygen condition so the bone marrow was stimulated to make more RBC'S And after birth the RBC'S will start to be broken down and their hemoglobin content will move to the liver and forming the

 ( مادة صفراء تنتج عن تكسير أو تحلل خلايا الدم الحمراء )**Bilirubin**

Which will move to the gallbladder and will be concentrated there and because of it's high amount the new born babe skin colour will be noticed as yellowish but sometimes it can affect the basal ganglia in the brain of the babe and could be really serious so the doctor needs to monitor the amount of bilirubin in his gallbladder if it's increasing then there is a problem and if it started to decrease then his body is adapting and getting back to normal .

\*the most important feature of the RBC'S is their flexibility and the evidence for that some of the small capillaries their diameter is 3 Mm which is smaller than the RBC's but still the RBC can get in it due to it's flexibility

\*the older the RBC the less it's flexibility and the day 90 of the life of the RBC and it's flexibility for the RBC is less so it's blocks some capiliries and the bloodflow can remove it but if it wasn't removed it might cause a clot .

\*the old RBC's are broken down in the spleen (don't be confused this organ was the first organ to produce RBC's during embryonic life but in our body it destroy them )

***How the spleen breakdown old RBC'S :- (VIP )***

Inside the spleen there are 2 types of circulation :-

1-closed circulation :- which is the circulation that is found throughout the body , RBC gets in the artery go to the capillary and then to the vein

2-open circulation :- the RBC get out of the artery into reticular fibers of the spleen , these reticular fibers form a network which have meshes (openings ) inside of it, these meshes have 3 Mm diameter so the RBC's that are young and flexible will pass through these meshes into a vein on the otherside and then they get back to the circulation, but the old RBC'S that are not flexible will not pass through these meshes and will get trapped in the reticular network until macrophages get rid of them by phagocytosis . (concentrate please :D )

\*In large blood vessels RBC'S Will adhere to one another to form stacks called **Rouleaux** And they start to separate from each other when the blood vessel starts to branch .

***The compenents of the Erythrocytes :-***

The RBC cytoplasm lacks most organelles and it Is composed of 40 % lipids , 10% carbohydrates , 50 % proteins some of these proteins are enzymes that are important for glucose metabolisim

The Erythrocytes proteins are :

1-Hemoglobin: tetrameric O2 carrying protein that is responsible for the acidophillia of the RBC when it binds with O2 hemoglobin forms Oxyhemoglobin and when it binds to Co2 it forms Carbaminohemoglobin.

2- Band 3 protein and Glycophorin A :they are integral proteins that function as ion channels

3-Antigen proteins on the surface of RBC that forms the basis of ABO blood typing system

4-Ankyrin proteins:- that help to anchor Glycophorin A and Band 3 proteins

 ***Leukocytes :-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

- According o the types of granules in the cytoplasm , the WBCs are classified into :

 1) Granulocytes : possess 2 major types of granules : lysosomal or Azurophilic granules and specific granules which binds acidic ,neutral and basic stains , granulocytes have an polymorphic nuclei with 2 or more nuclear lobes

 Granulocytes include : neutrophils,eosinophils,basophils

 2) Agranulocytes : possess azurophlic granules(lysosomal) and it does not have specific granules so it has an affinity for basic stains and it's nuclei is spherical and not lobed .

Agranulocytes includes :Lymphocytes and Monocytes



The most widely distributed type of WBCs in the blood is neutrophils ( 54-62% ) , this indicates that when the patient suffers from Leukocytosis (  increase in the amount of WBCs in the blood ) that also indicates an increase in the number of neutrophils .

- The arrangement of WBCs according to their number in the blood neutrophils are found with the greatest amount , then the lymphocytes then monocytes , eosinophils then basophils

***Neutrophils :-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

their nucleus is multi-lobe ( 3-5 lobes ) , and sometimes we find the x-chromatin suspended in the peripheral lobe ( these inactive x-chromatin indicates that cells belong to the female but no presence of x-chromatin not surely mean the cells belong to male , it means the cells maybe belong to male or female ) .

Specific granules in the neutrophils secret Alkaline phosphate and collagenases

The Azurophilic granules secret Acid phosphates and collagenases it also secret elastase A and this enzyme degenerate certain fibers inside the ECM around the cells to facilitate their mobility

 ***Eosinophils:-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** they constitute 1 to 3 % of the leukocytes ( and they increase in the allergic states , or in children when they eat polluted food )

\*in cases of eating polluted food that will cause certain parasites like worms to live in the small intestine and the blood accumulated around that region will have a relatively high percentage of Eosinophils .

they contain specific granules ( these granules causes a lot of changes in the color density under the EM , light then dark then light area ). The dark area is called enternum , and the light area surrounded it , called externum – The enternum contains major basic protein ( the most important secretory products of eosinophlis ) , they attack the worms especially in the anus.

 these cells are similar to mast cells : even when they are near the circulation , the secretory products of these cells will affect on the blood vessels ( the heparin affects on the blood inside the vessels , and the histamine affects externally )

  ***The basophils:-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** they make up less than 1% of the blood leukocytes and therefore they are hard to find , their nucleus is divided into 2 lobes (they are similar to mast cells and same to the eosinophils :same secretory products , same morphological structures , but they are different in the embryonic origins ) Their  granules are strong basophilic and exhibit metachromasia like the mast cells because of the presence of sulfated GAG like heparin .

\*metachromasia :- is the ability of the cell to change the color of basic dies .

***The lymphocytes\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***  it is the main cells in the immune system and the most widely distributed type of Agranulocytes .

 It has a spherical nuclei they are the smallest leukocytes and subdivided into T-lymphocytes and B-lymphocytes and natural killer NK cells . these cells play a main roles in the immunity system against invading microorganisms and abnormal cells . Their diameter is 9 to 18 Mm Their cytoplasm is basophilic and contains a few non-specific granules . They contain highly condensed chromatin .

***-The monocytes\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***  they are precursor cells of Macrophages ,osteoclasts and other cells of the **Mononuclear phagocyte system** and all the monocyte-derived cells play an important role in the defenses against the foreign microorganisms.

Their diameter is 12-15 Mm and their nucleus is C-shaped) their chromatin is less condensed , and their cytoplasm is basophilic .

***The palates(thrombocytes )\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*** they are non-nucleated particles , 2-4 Mm in diameter , they are originated by separation from the ends of cytoplasmic processes extending from giant polyploid bone marrow cells called megakaryocytes . the main function of palates promotes the blood clotting and help repair tears or leaks in the wall of small blood vessels preventing loss of blood from them.

-**they have a lifespan of 10 days**

- The platelet is discoid  ( O-shaped ) with a very  lightly stained peripheral zone called Hyalomere and a  darker stained central zone containing granules called Granulomere .

 - In the ultra-structural study of the palate , we will see the marginal bundle ( microtubules and microfilaments ) that play an important role in the maintain of the platelets shape .