Introduction to Hematology

The word of hematology comes from two words, the Greek haima (means blood) and logos (means discourse); therefore, hematology is the science of study blood cells components and coagulation.

Hematology included comprehensive study include:

1-analyses of blood components concentration

2-structure, and function of cells in blood

3-precursors of blood cells

4-determine chemical and physical features of blood

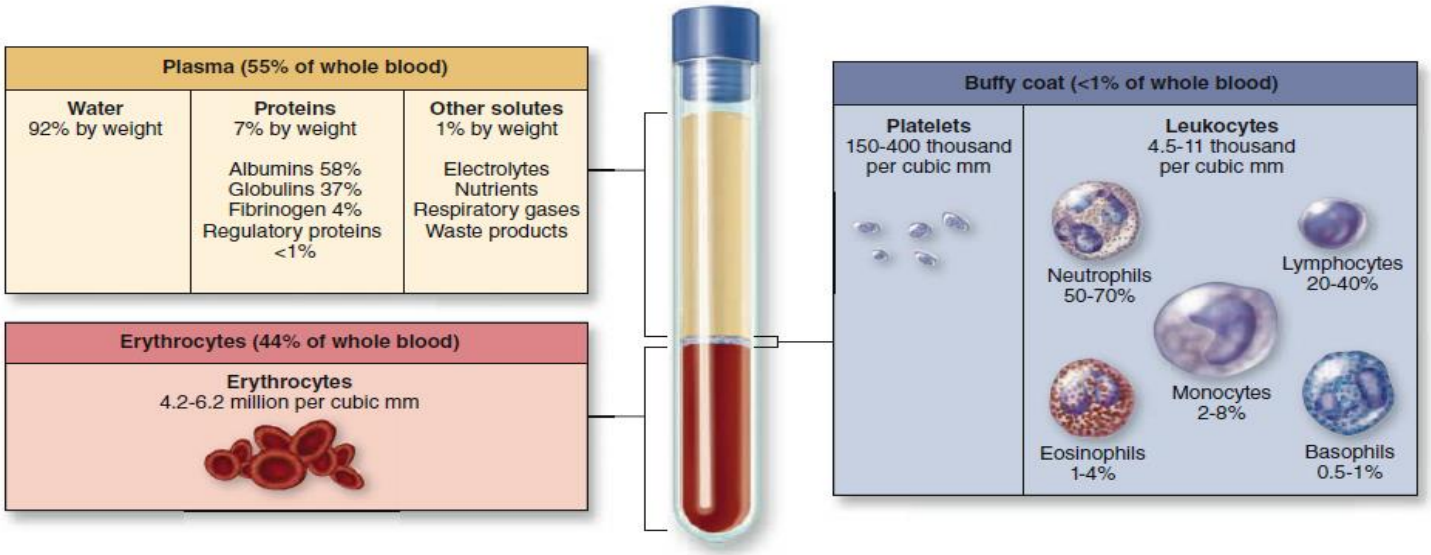
5-platelets and proteins that important in blood coagulations

6-main ailments of blood.

What is Blood?

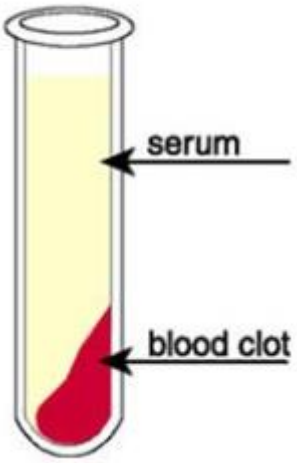
It is a specialized connective tissue, that is a body fluid in humans and other animals, which delivers nutrients and gasses (O_2 and CO_2) to the cells, also transports metabolic waste away from those same cells, it propelled mainly by rhythmic contractions of the heart, within the closed circulatory system.

Blood components: after centrifugation of blood samples with anticoagulant factor: that produce three layers:



1- Plasma 55% (**proteins**, water, electrolytes, nutrients and waste)
2- Buffy coat <1% contain: platelets and leukocytes (WBC : white blood cell)
3- Erythrocytes 44% (RBC : red blood cell)

But when centrifugation of blood without anticoagulant factors, we are see two layers: serum and blood clot.



Serum is pale yellow fluid of blood which doesn't play any role in clotting, or its plasma of blood without clotting factors, or as blood with all cells and clotting factors removed.

Serum contain all proteins not used in blood clotting; all electrolytes, antibodies, antigens, hormones; and any exogenous substances such as drugs.

Physical features of blood:

1-Color: red because contain **hemoglobin** on RBC surface

2-Temperature: it has same degree of body 37C˚

3-Density: which depend on solutes concentration in plasma of blood and cellular concentration (RBC, WBC, platelets) in whole blood.

Normal values of density:

Male: 1.057 --- 1.067 gm/cm^3

Female: 1.051 --- 1.061 gm/cm^3

4-Viscosity: that result from friction of blood with vessels wall, and depend on proteins concentration (specialized fibrinogen)

Normal values of viscosity: 5-6 times more than water, measure by m^2/sec

5-Osmotic pressure: which come from crystals of salts in plasma and it's important to maintain equilibrium between salts and liquid between inside and outside (blood vessles) of cells, osmotic pressure for plasma 5000 --- 5200 mm/hg.

6-Power of hydrogen (PH): blood is alkaline in normal range, artery blood has 7.4, but in vein 7.35, and in cell blood has 7 – 7.2 because CO^2.

7-Volume: 5-6 L in adults (Infants have a larger blood volume in proportion to body weight than adults).

Blood contain plasma, cells and platelets:

1-Plasma: is yellow liquid part of blood which contain cells of blood and configure 55% from blood, have density 1.027 gm/cm^3.

Components of plasma:

a-Water: 90%

b-Organic materials: 9% that include:

Proteins (albumin 55%, globulin 38% and fibrinogen 7%) configure 8-6% from plasma.

Non-protein materials include secretary materials (such as creatinine and uric acid) and nutrition (such as glucose and lipid).

c-Non-organic materials:

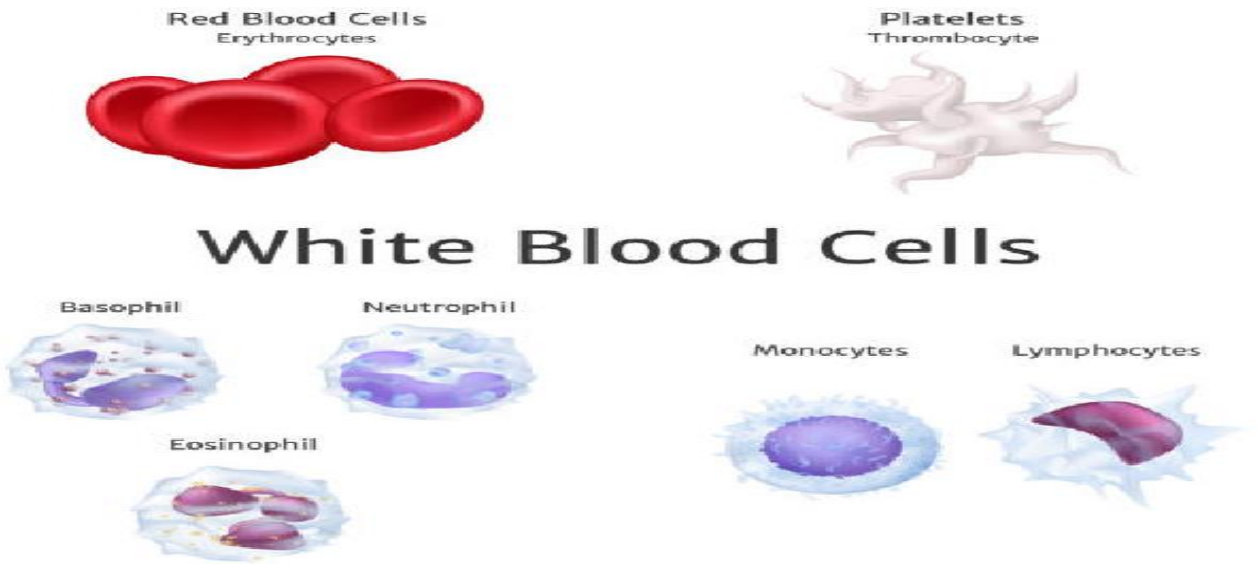
includes ions such as (Fe^{++}, K, Na, Ca, Mg, Cl- and HCO_3).

2-Cells:

a- **Erythrocyte (Red blood cells RBC):** that wrong called cells because don't has features of cells, don't has nucleus, it biconcave shaped, it was get energy by anaerobic oxidation of glucose because doesn't contain mitochondria, which has very important rolls in the life because contain hemoglobin (gave red color) that responsible for gases transport (O2 and CO2) to survive. It was lack organelles to provide surface for vital function (transporters), and without ability to divided and generation.
Normal value of RBC: (number of cell per million in one milliliter of blood sample)
Male: 4.7 – 6.1 million/mil.
Female: 4.2 – 5.4 million/mil.

b- **Leucocyte (White blood cells WBC):** the normal range of WBC 4000-11000 cell/mm^3 include two types:
granular (basophil, neutrophil and acidophil)
and a granular (monocyte and lymphocyte).

c-platelets: circular bodies, unlike cells that don't contain nucleus and other organelles, normal value of: 150,000 - 450,000 plt per microliter or 150 – 400 × 10^{9} / L.



Functions of blood:

1- Respiratory: transport O_2 from lungs tissues to all cells of body by artery, also transport CO_2 from body cells to lungs.
2- Nutritive: also blood transport nutrition from digestive system to cells and deliver metabolic wastes to decretory organs.
3- Regulation of body temperature: distributed heating energy in all body by movement in all blood vessels.
4- Regulation of metabolism: by transport hormones from manufactured place to all body cells that regulated catabolism and anabolism.
5- Defenses: this function specialized for WBC, which have ability to engulfs microbes, also blood contain important antibodies against antigen.
6- Water balances: transport and excretion high amount of water from kidney and urinary tract.
7- Buffering: regulate concentration of hydrogen ions, by contain specific components for process.

References:
1-Loffler, H., & Rastetter, J. (2012). *Atlas of clinical hematology*. Springer Science & Business Media.
2-Hoffbrand, A. V., & Steensma, D. P. (2019). *Hoffbrand's essential haematology*. John Wiley & Sons.
3-arabic reference: Al-shaeer, A., M., et al., (1991). book of blood science, AL-AHLYIA publisher, Jordan.