



# ***Hematology & Lymph system***



# ***Physiology***

☒ Sheet

☐ Slide

☐ Handout

***Number: 1***

***Subject: Blood***

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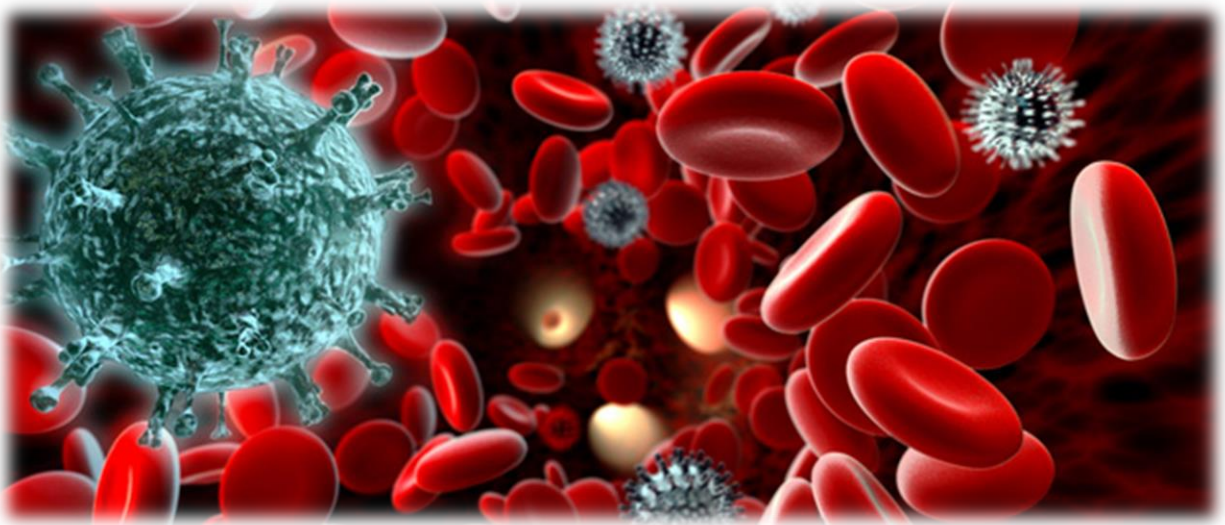
***Corrected by : Noor Isbeih***

## ***Introduction***

- **Hematology and lymph system (MLS)**, is a branch of medicine concerned with the study, diagnosis, prevention and treatment of blood and lymph disorders. In MLS physiology we are going to review body fluids and the concept of the blood, then we will talk about each type of blood cells and hematopoiesis, we will study also gas transport and hemostasis.

- This lecture will give you an idea about the blood and body fluids.

## ***What is the blood ?***



- In the average 70-Kg man, the total body water is about 60% of the body weight or about 45 liters of fluid, 5 liters of these are blood.

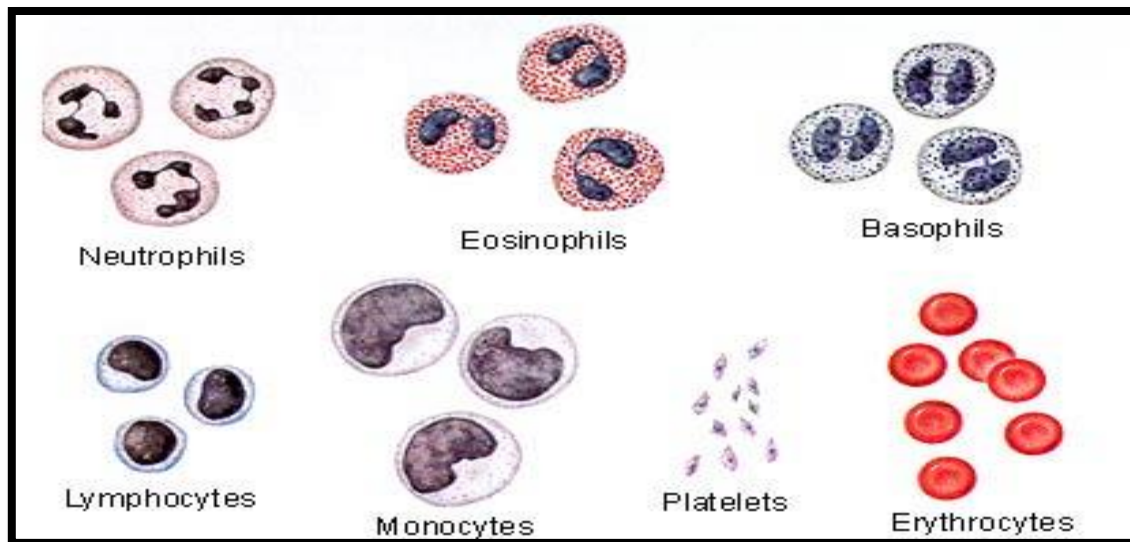
- So, **five liters of the body fluids are blood.**

- The blood is a specialized connective tissue, that's composed of :

- 1- **plasma** 55%

- 2- **blood cells** 45%:

- If we take a tube full of uncoagulated blood (doesn't clot) and we centrifuge it for (5-10) minutes, we find that 45 percent is cells and 55 percent is plasma
- Blood cells are:



Cell type	Typical cell count
1- <b>Erythrocytes</b> (red blood cells- RBCs)	$5 \times 10^{12}$ (men) $4.5 \times 10^{12}$ (women)
2- <b>leukocytes</b> (white blood cells- WBCs):	$7 \times 10^9$
neutrophils	$5 \times 10^9$ (40-75%)
eosinophils	$100 \times 10^4$ (1-6%)
basophils	$40 \times 10^6$ (<1 %)
lymphocytes	$0.4 \times 10^9$ (2-10%)
monocytes	$1.5 \times 10^7$ (20-45%)
3- <b>Platelets</b>	$250 \times 10^7$

● Normal red blood cell values are: (number of cells/ Volume unit):

- In males: 5 million cells per  $\mu\text{l}$
- in females: 4 million cells per  $\mu\text{l}$
- Males have higher RBCs count than females because of some hormones like androgens (I.e.: testosterone) which stimulate RBC synthesis
- Volume units we use when counting RBCs are:
  - 1) Microlitre ( $\mu\text{l}$ ) = Millimeter cubed ( $\text{mm}^3$ )
  - 2) Millilitres (mL)
  - 3) Litres (L).
- Supposedly the RBC count was 5 million cells ( $5 \times 10^6$  cells) then:

$5 \times 10^6 \text{ (cells/ } \mu\text{l)} = 5 \times 10^6 \text{ (cells/ mm}^3\text{)} = 5 \times 10^9 \text{ (cells/mL)} = 5 \times 10^{12} \text{ (cells/Litre).}$

## ***plasma composition***

● remember that the plasma is the blood without cells, it basically contains everything!, but the main components of the plasma are:

- **Water** ranges from 90 to 92 percent.
- **Electrolytes**, Na, K, Cl... (less than 1 percent)
- **gases** O<sub>2</sub>, Co<sub>2</sub>... (very low)
- **nutrients**
- **waste products** (bilirubin, uric acid).
- **plasma proteins** (albumins, fibrinogens, globulins and prothrombin)

## ***Plasma proteins***

● One of the most important components of the plasma are proteins, almost all blood functions are protein dependent in a way or another. Main plasma proteins are:

- albumins
- fibrinogens
- globulins
- prothrombins

● There are over 1400 different plasma proteins but these are the most important ones.

● All plasma proteins are produced by the liver.

- Special type of globulins, Immunoglobulins have another source of production which is the lymphocytes.

● Functions of plasma proteins:

- Transport functions (for gases, hormones, nutrients.. etc)
- Defense functions by the immunoglobulins
- Blood coagulation
- Reserving body proteins
- Exchange of fluids between the by blood and tissues by the oncotic or colloidal pressure which is:

- produced mostly by albumins.
- Range from 25-28 millimeter mercury. (some books say it's 32)

### Clinical hint:

In liver diseases (like hepatitis or cirrhosis) the rate of proteins produced by the liver will decrease, and therefore its concentration decreases. This will cause **edema** (due to albumin deficiency) and **coagulopathy** (due to fibrinogens deficiency).

### Biochemical correlation:

- amino acids in proteins are either essential or non essential amino acids.
    - **Essential amino acids:** Amino acids that are required for life and growth but is not produced in the body, or is produced in insufficient amounts, and must be supplied by protein in the diet.
    - **Non essential amino acids:** Amino acids that are required for protein synthesis and can be synthesized by humans. ● Now there are complete proteins and incomplete proteins
    - **Complete proteins** provide all essential amino acids in order to sustain normal growth.
    - The most important complete proteins are: eggs, chicken and fish
- Incomplete proteins are provided by vegetables, so vegetarians usually have amino acid deficiency because incomplete proteins don't provide

## Blood PH

- In order to perform all physiological functions, It's important to maintain plasma PH in a limited range.
- PH of Some body fluids:
  - The pH of the **gastric juice** is less than that of lemon juice.
  - The highest pH (very basic) is for **bleach and cleaners**.

❖ The pH scale of blood is different than that of water.

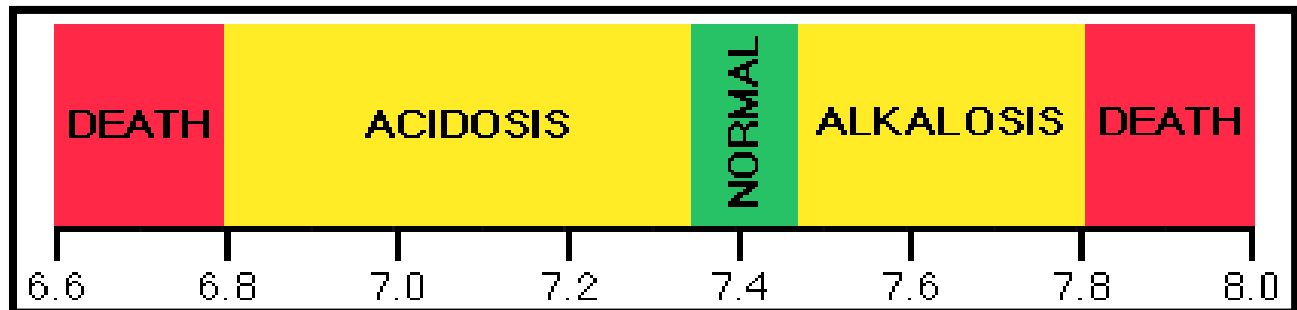
Water:

-acidic pH <7      -basic: pH >7

❖ Blood:

-acidosis pH < 7.35      -alkalosis: pH > 7.45

- The range of the normal pH of the blood is **from 7.35—7.45**.
- The change **below is 6.8 or above 8** causes death.



- How does the pH affect the human being?
  - It can **denature enzymes**
  - affects CNS**
  - Affects **Potassium pumps** (because there is a close relationship between the hydrogen atoms and the potassium, they're always together), so entry and exit of Potassium is altered.

## ***Functions of the blood***

### ● **Transport functions:**

- transports carbon dioxide CO<sub>2</sub> , O<sub>2</sub>, free nutrients, waste products, hormones (from endocrine cells), enzymes to various cells .

### ● **Regulates “body” pH through buffers and amino acids.**

● **Plays a role in regulation body temperature**, because it contains large volume of water.

● **Regulates cells water content**, by dissolving sodium and chloride ions, the main electrolytes, which change the osmolarity of the blood.

● **Prevents body fluid loss through the clotting mechanisms.**

- **Protects against toxins and microbes**, through special cells: white blood cells.

## ***Blood distribution***

- When we talk about the blood the first thing that goes to the mind is the heart, but this is actually not accurate ( شو بدو يتحمل ليتحمل هالقلب ) :p
  - The blood is mainly in the Veins (65-75%), Arteries 10-15% Capillaries 5%, heart 5% and it's just 5 ! lungs 10%.
- There are physiological changes in the blood volume are due to:
  - **gender**; there is a difference between males and females (males have a higher blood volume)
  - **pregnancy**; pregnant woman have more plasma and blood volume.
  - **muscular exercise**; increases blood volume.
  - **posture**, in standing position there is a reduction in blood volume of about 15% (it goes to the interstitial fluid)
  - **blood pressure**; rising blood pressure lowers blood volume
  - **Altitude**; increases blood volume.
  - **excitement**; because of adrenaline release.
  - **contraction of spleen**, as it contains blood.
- And that concludes today's lecture :p
- *"It is our attitude at the beginning of a difficult task which, more than anything else, will affect its successful outcome."*

- William James

- *best of luck*
- *Mohammad qussay Al-Sabbagh*

***The end***