

# Physiology – first lecture

\_Fluids in a “normal” human body make 45 liters . “normal” : means weight is 70 kg ,height is 170 cm .

\_45 liters of fluids constitute 65% of body weight .

\_blood constitutes 5 liters from the total 45 liters (\_again in a “normal” human being).

\_if we take a tube full with blood and waited 5-10 minutes we will get:

45% cells

55% plasma

>Cells :\_you know blood cells: red ,white and platelets . which are also called : erythrocytes,leukocytes and thrombocytes ,respectively .

#erythrocytes:

there is a difference in the count of erythrocytes between males and females . :

In males :the approximate normal range is from 4.3 to 5.9 million, but usually we say 5 million erythrocytes in a “normal” male .

in females: from 3.5 to 5.5 million. If want to use one number it is 4 million .

This number of erythrocytes is per 1 micro liter(  $\mu\text{L}$  ) ,or, 1 cubic millimeter( $\text{mm}^3$ ) . (they are equivalent ) .

Androgens make this difference in RBC count between males and females.

#leukocytes:

Normal range : from 5000 to 11000 pe  $\text{mm}^3$  and, there is no difference between males and females . the difference is between individuals .

According to percentage (higher to lower) : neutrophils > lymphocytes > monocytes > eosinophils >basophils

#thrombocytes (platelets)

range :  $(150 \text{ to } 450) \times 10^3 / \mu\text{L}$  (or per  $\text{mm}^3$ ) .

>plasma:

components :

-Mainly water : 90% / 91% / 92%

-electrolytes : less than 1%, such as  $\text{Na}^+$  , $\text{K}^+$  , $\text{Ca}^{++}$  , $\text{Cl}^-$  ,...etc.

-gases : about 1% , such as  $\text{O}_2$  ,  $\text{CO}_2$  .

-nutrients : glucose ,aminoacids ,lipids ,cholesterol ,vitamins .

- waste products : also about 1% , such as urea ,uric acid ,bilirubin, creatinine .
- plasma proteins : 7% , they are very important doing very important functions .

The main plasma proteins:

\albumin : 4.5 mg/100 ml

\Globulins : 2.5 mg/100 ml

\fibrinogen : 0.3 g/100 ml

\prothrombin : less than 0.19mg\100ml

4000 different types of plasma proteins have been identified , constitute 6-8g/dl .function as enzymes ,hormones ,antibodies ,transporters. also contributes in plasma osmolarity ,acid-base balance , and sometimes they are source for energy .

pH :

you know , ranges 0-14 . neutral PH is 7 (distilled water) ,above 7 basic/alkaline and below it acidic.

“You remember” that gastric juice is even more acidic than lemon juice .

the most basic is oven cleaner ! .

“neutral” blood pH is 7.4(ranges) not 7 : that means below 7.4 acidic and above it basic.

ranges between 7.35-7.45 ,very narrow range , a change in blood pH could cause death ( the Dr said “any” change but it seems not precise) . \*\*wiki. info. : Acidosis is said to occur when arterial pH falls below 7.35 (except in the fetus ) , while its counterpart (alkalosis) occurs at a pH over 7.45\*\*

What mainly makes changing PH such fatal ?

denaturation of enzymes, leading to function loss , also  $\text{Na}^+ / \text{K}^+$  pump will stop functioning.

Death occurs when blood pH goes higher than 8(basic conditions) ,or below 6.8 (acidic conditions).

abnormalities will precede death when pH goes out of the 7.35-7.45 range , but when reaches either below 6.8 or higher than 8 ,death occurs .

General functions of the blood :

1-transport functions : transports carbon dioxide  $\text{CO}_2$  , $\text{O}_2$  transport, free nutrients, waste products, hormones (from endocrine cells), enzymes to various cells .

2-regulates “body” pH through buffers and amino acids.

3-plays a role in regulation body temperature, because it contains large volume of water.

4-regulates cells water content , through dissolving sodium and chloride ions ...the main electrolytes ,which change the osmolarity of the blood.

5-prevents body fluid loss through the clotting mechanisms

6-protects against toxins and microbes , through special cells white blood cells.

Again, main plasma proteins are 4 : albumins globulins fibrinogens and prothrombins , and there are many other plasma proteins ;thousands . almost all of them are produced in the liver any problem in the liver will affect plasma protein , such as cirrhosis and hepatitis (C mainly not A or B), the exception of production origin is for gamma globulins which are produced by lymphocytes .

A summary of the functions of plasma proteins :

a) transport functions :  $\alpha$  and  $\beta$  globulins .

b)defense : immunoglobulins

c)reserve body proteins .

d)colloid osmotic pressure or, oncotic pressure, 25-28 mm Hg , mainly established by albumins ( participate in more than 60% of the pressure).

e)viscosity of plasma : mainly by fibrinogens and globulins as well as other plasma proteins . viscosity of blood is mainly achieved by red blood cell , but when talk about the role of plasma proteins in viscosity : we talk about fibrinogens and globulins.

f)clotting : the formation of fibrin clot , fibrinogen is essential for normal clotting , if it's absent a blood loss occurs .another very important plasma protein participating in clotting process is prothrombin .

\_a second function of albumin ( beside colloidal osmotic/oncotic pressure ) is to transport : fatty acids ,hormones ,drugs!, and other substances .

-as albumins are produced by liver , a low concentration of albumins in the serum indicates liver disease and/or malnutrition .

®What is the "function" of colloidal osmotic pressure ?

Fluid exchange between capillaries and interstitial spaces.

so again oncotic pressure 25-28 mm Hg permits fluid exchange .

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\_there are essential amino acids and non essential amino acids ,accordingly , there are complete proteins and incomplete proteins .complete proteins provide us with all essential aminoacids ,while incomplete don't .

®"who can give me " 3 types of food that provide us all essential amino acids ,from the most important to third ?

1-eggs 2-fish 3-chicken .

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\_hemoglobin : hemoglobin role in pH and carrying other elements such as carbon dioxide ,is more important than plasma proteins' ,why ?

(not answered by the doctor! ,wants us to find it out that )

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\_blood distribution : the first thing that goes to the mind is the heart , but this is actually not accurate , the blood is mainly in the **Veins** , Arteries 10-15% Capillaries 5% ,heart 5% and it's just 5 ! ,lungs 10% .

\_there are physiological variations in blood volume ,that are normal :

1-gender ;there is a difference between males and females .

2-pregnancy; pregnant woman has more plasma and blood volume.

3-muscular exercise ,increases blood volume.

4-posture,in standing position there a reduction in blood volume ,about 15% .

5-blood pressure ; rising blood pressure lowers blood volume.

6-Altitude increases blood volume

7-excitement; because of adrenaline release .

8-contraction of spleen, as it contains blood .