

# Human Physiology

Lecture 5 – Wednesday 24/2/2016

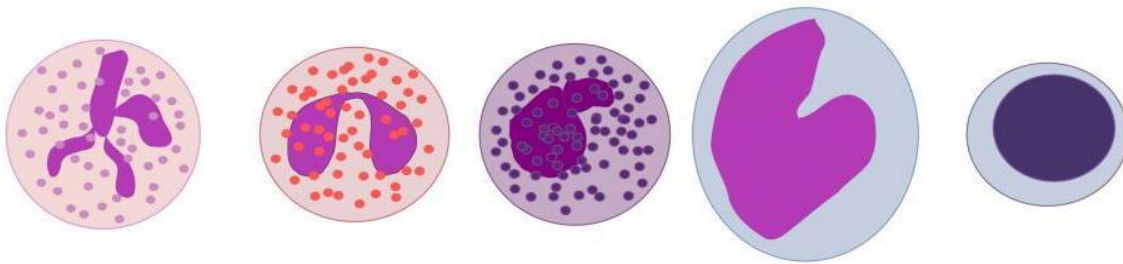
“Leukocytes, Hemostasis & Blood Grouping” with Dr.

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**PharmaGlory 15**

Note: RBC= Red Blood Cell, WBC = White Blood Cell  
[B] = from the book, not the lecture.

# White blood cells



neutrophil eosinophil basophil monocyte lymphocyte

Reminder:

- Neutrophils (60-70%, with range of 3000-6000)
- Eosinophils (2-4%, with range of 150-300)
- Basophils (0.5-1%, with range of 0-100)
- Lymphocytes (20-25%, with range of 1500-3500)
- Monocytes (3-8%, with range of 300-600)

**Neutrophils** (60-70%) (10-12  $\mu\text{m}$ )

- Their major role is phagocytosis (البلعمة), and they are the first line of defense in the body against any agents
- Their granules contain the digestive enzyme **lysozyme** (and this enzyme is the enzyme that destroys foreign agents)
- They can squeeze from the blood vessels into tissues but it can never return back to the blood

- Formed in the bone marrow, and lasts 4-8 hours in the blood & 4-5 days in the tissues

### Eosinophil (2-4%) (10-12 $\mu\text{m}$ )

- Their major function is to produce **antihistamine**.
- Their granules (حبيبات) contain **profibrinolysin**, an enzyme responsible for dissolving/removing blood clots
- Formed in the bone marrow
- A high level of Eosinophils in the body indicates an allergy (like asthma) or parasitic (طفيليات) conditions
- Lasts 12 hours in the blood & 20 hours in the tissue

### Basophil (0-1%) (8-10 $\mu\text{m}$ )

- Contains powerful chemicals like **histamine & heparin**.  
Histamine: result of an antigen-antibody reaction.  
Heparin: maintaining the normal balance between the clotting and anticlotting systems.
- They can squeeze from blood to the tissues, where they become **mast cells**.

### Lymphocytes (20-25%)

- Most formed elements come from the bone marrow...  
However, only a few of the lymphocytes come from the bone marrow.  
Most of them come from lymphoid tissue of the body (lymph nodes, tonsils, spleen, thymus)
- There are large (10-14  $\mu\text{m}$ ) & small lymphocytes (6-9  $\mu\text{m}$ ).
- **B-lymphocytes**: produces antibodies, short life of few hours
- **T-lymphocytes**: directly destroys cells, lives for 200+ days

## Monocytes (3-8%) (12-20 $\mu\text{m}$ )

- Largest cell in the blood
- Formed from red bone marrow
- After 24 hours they leave blood and enter tissues to become tissue macrophages
- An increase in monocytes indicates a chronic (مزمن) infection like **tuberculosis**
- Contains peroxidase & lysozyme enzymes, as it is phagocytic
- Average life of 10-20 hours in blood, and months/years in tissues

What happens when the level of production of WBCs decreases or increases?

## Leukopenia

- Leukopenia is a **decrease** in the production of WBCs.
- The body lacks protection when leukopenia happens
- Within 2 days, ulcers (قرحات) in the mouth start to form
- Without treatment, it can cause death in 3-6 days.

## Leukemia

- Leukemia is an increase in the production of non-functional WBCs.
- These non-functional WBCs start to surround the red bone marrow, causing a decrease in the production of RBCs/platelets.
- [B]: Leukemia results in anemia due to a reduction in RBC count, and internal bleeding due to lack of platelets.

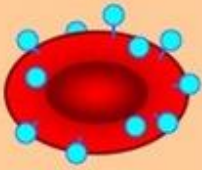




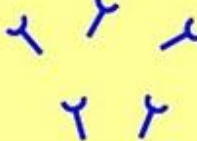


The 3<sup>rd</sup> type of formed elements in the blood is the **thrombocyte** (platelets)

- Major function is blood clotting
- They are disc-shaped cells without a nucleus.
- Average diameter of 4  $\mu\text{m}$ , and they have a very short life, and are formed in the bone marrow.

## Hemostasis

- Hemostasis is the prevention of blood loss.
- 4 types of reactions take place as a result of hemostasis:
  - Vascular spasm
  - Formation of platelet plug
  - Blood coagulation (the only one we need to know)
  - Growth of fibrous tissue into the blood
- Blood coagulation (تخثر الدم) is divided into 3 different stages:
  - Stage I: **Thromboplastin** (enzyme) is released from thrombocytes
  - Stage II: In the presence of Thromboplastin & Calcium ions, prothrombin is converted into **Thrombin**.
  - Stage III: In the presence of Thrombin, Fibrinogen is converted into **Fibrin**.
  - Fibrin is what makes up the blood clot.
- Any deficiency in 1 of 13 clotting factors causes a longer bleeding time. The normal bleeding time is about 3 minutes.

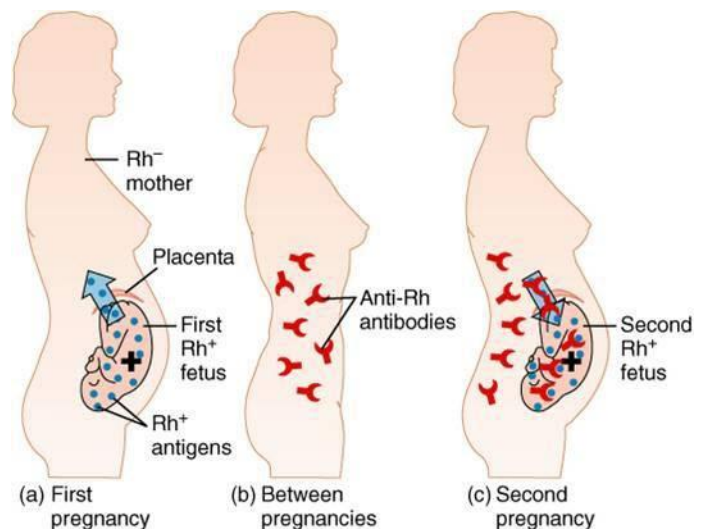
## Blood grouping by ABO system:

<b>Antigen</b> (on RBC)	Antigen A 	Antigen B 	Antigens A + B 	Neither A or B 
<b>Antibody</b> (in plasma)	Anti-B Antibody 	Anti-A Antibody 	Neither Antibody 	Both Antibodies 
<b>Blood Type</b>	<b>Type A</b> Cannot have B or AB blood Can have A or O blood	<b>Type B</b> Cannot have A or AB blood Can have B or O blood	<b>Type AB</b> Can have any type of blood Is the universal recipient	<b>Type O</b> Can only have O blood Is the universal donor

## Rh system:

- Rh system describes antigens like: C, D, E.
- D is the most common antigen, and D is referred to as “positive”.
- There are NO antibodies for these antigens under normal condition.
- However, Rh system affects pregnant women.
- If a woman with Rh- blood is pregnant with a child with Rh+ blood:

- First pregnancy: No problem occurs, a normal child is born
- Second pregnancy: Anti-Rh antibodies are in the woman's blood and will try to enter the placenta in order to attack the fetus.



## Blood transfusion:

- Blood transfusion occurs when blood is taken from a blood donor (متبرع بالدم) and given to a blood recipient (متلقي الدم).
- 2 types of reactions can happen if the wrong type of blood is given to the blood recipient:
  - Major reaction:
    - ❖ Antigens in the donor's blood react with the antibodies in the recipient's blood.
    - ❖ Major reactions cause the antibodies in the recipient's blood to rupture the RBC membrane & this causes free Hemoglobin and fragments of the membrane circulating in the plasma.
    - ❖ 20-30% of the blood volume goes to the kidney for cleaning (to clean the hemoglobin and membrane fragments) and this causes kidney failure due to blood entering in small blood vessels in large amounts
  - Minor reaction:
    - ❖ Antibodies in the donor's blood react with the antigens in the recipient's blood.
- Special case: If you want to give O+ donation to O- blood, it can only happen one time. Just like the case with pregnant women, giving O+ blood causes the production of antibodies.

Note: The information here is from the lecture, slides, and the book (chapter 11, pages 322-326, 329-331)