

Hematology introduction



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المحاضرة 15- المرحلة الثانية
الطبيب الراطن تقنيات التخدير

Blood : - is highly specialized (sterile) connective tissues, which circulate in a closed system of vessels as a liquid with red color, but in out this system a solid phase will perform, which we called plug or blood clot.

Haematology :- is the science that study the blood, and it's structure, function, disease, and the convenience between structure and the function.

FUNCTION OF BLOOD

❖ *Transportation and distribution:*

- 1- Oxygen transportation by haemoglobin from lungs to the tissues.
- 2- Blood also can transport the nutrients absorbed by the digestive system to the tissues for use or storage
- 3- Hormones are carried from endocrine glands to the organs.
- 4 - Wastes are transported from tissues for excretion e.g.: carbon dioxide, urea, creatinine...

❖ *Regulatory:*

- 1- plasma maintain the PH. of blood (7.35-7.45), and in the tissues
- 2- Osmotic pressure in plasma is regulated by proteins and salts (sodium, chloride) to prevent excessive loss of fluids from the blood into tissue.
- 3- Regulation of the body temperature

❖ Protective:

- 1- Platelets and coagulation factors control the blood loss by thrombus formation.
- 2- Leukocytes defend and produce antibodies and toxin against infection and tumor cells.

BLOOD COMPONENT:- Mainly we can divide blood into two parts:-

1 - Blood cells

2 – Plasma

The total amount of blood approximately 1/14 of the total body weight or 60-70 ml/ each kilogram of body weight Blood flows through every organ of the body providing effective communication between tissues. **PLASMA** : - Plasma is a pale yellow fluid in which blood cells are suspended in. Plasma forms about 55% of blood volume and composed of 95% or more water, and many solutes including proteins, minerals, ions, organic materials, hormones, enzymes, products of digestion, and waste products

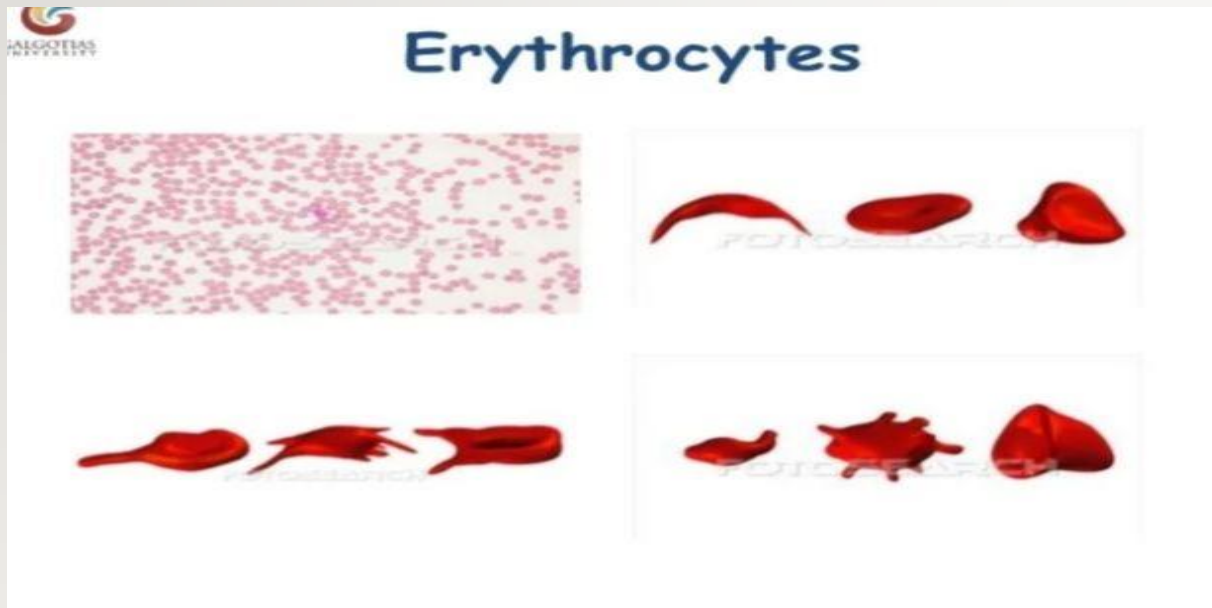
Blood Cells Type

◇ Erythrocytes) RBC)

Function - transport of gases

Do not contain nucleus and mitochondria Main protein - hemoglobin (35%) Energy - from glycolysis

Life span - 120 days Formation is stimulated by erythropoietin



Erythropoiesis : is the process by which red blood cells (erythrocytes) are produced. It is stimulated by decreased O₂ incirculation, which is detected by the kidneys, which then secrete the hormone erythropoietin. This hormone stimulates proliferation and differentiation of red cell precursors, which activates increased erythropoiesis in the hemopoietic tissues, ultimately producing red blood cells

◇ *Leukocytes)WBC):* have many types



Lymphocytes

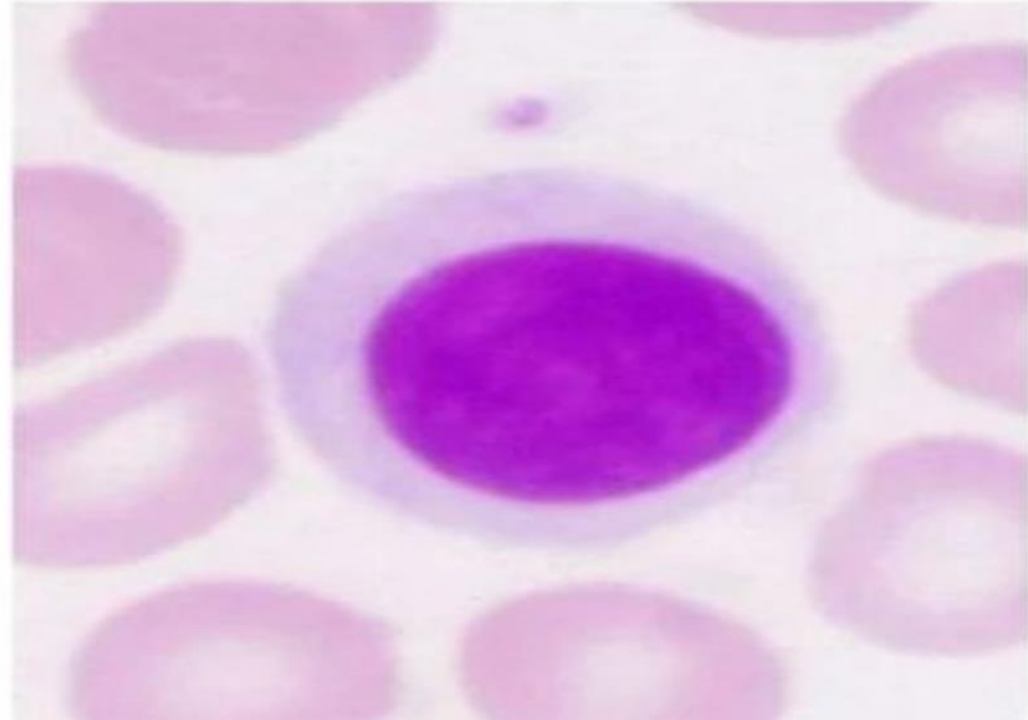
Function - formation of humoral and cell immunity

20-25 % of all leucocytes.

Intensive synthesis of protein - immunoglobulins

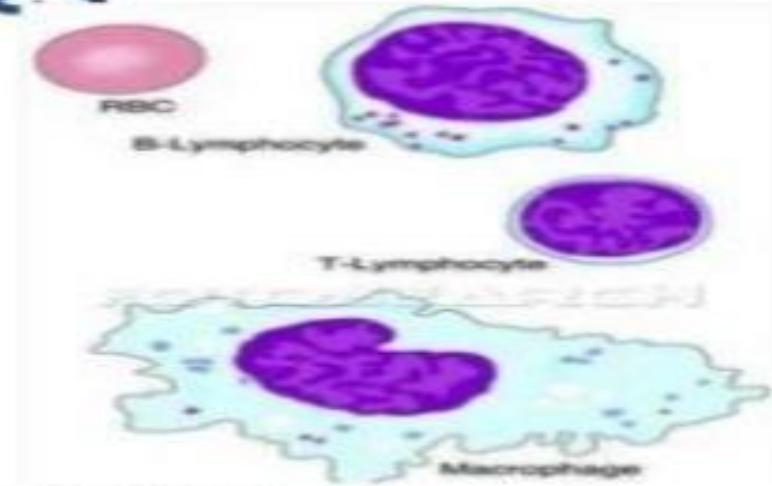
T- i B-limphocytes

Energy mainly from glycolysis



Physiological role of T-lymphocytes

- 1. Immune memory
- 2. Anti viruses immunity
- 3. Anti tissue immunity
- 4. Regulate phagocytosis



Function of B-lymphocytes

- 1. Immune memory.
- 2. Specific immunity. B-lymphocytes synthesises the immunoglobulins such as IgM, IgN, IgA, IgG, IgB, IgE.

◊Thrombocytes



Thrombocytes

Function - formation of blood clot

<1 % of all leucocytes

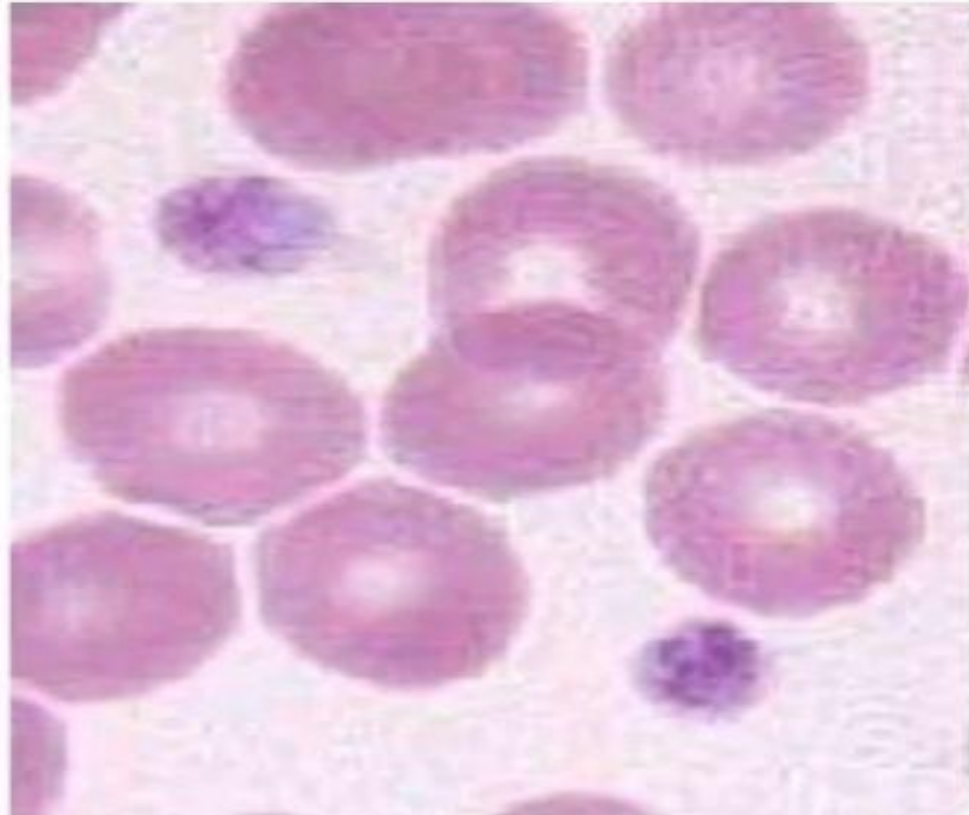
2 types of granules:

- dense (ATP, serotonin, catecholamines);
- alpha-granules - lysosomes

Synthesize actin, myosin, troponin

Synthesize prostaglandins and thromboxans

Main reactions: adhesion, aggregation, secretion



Monocytes

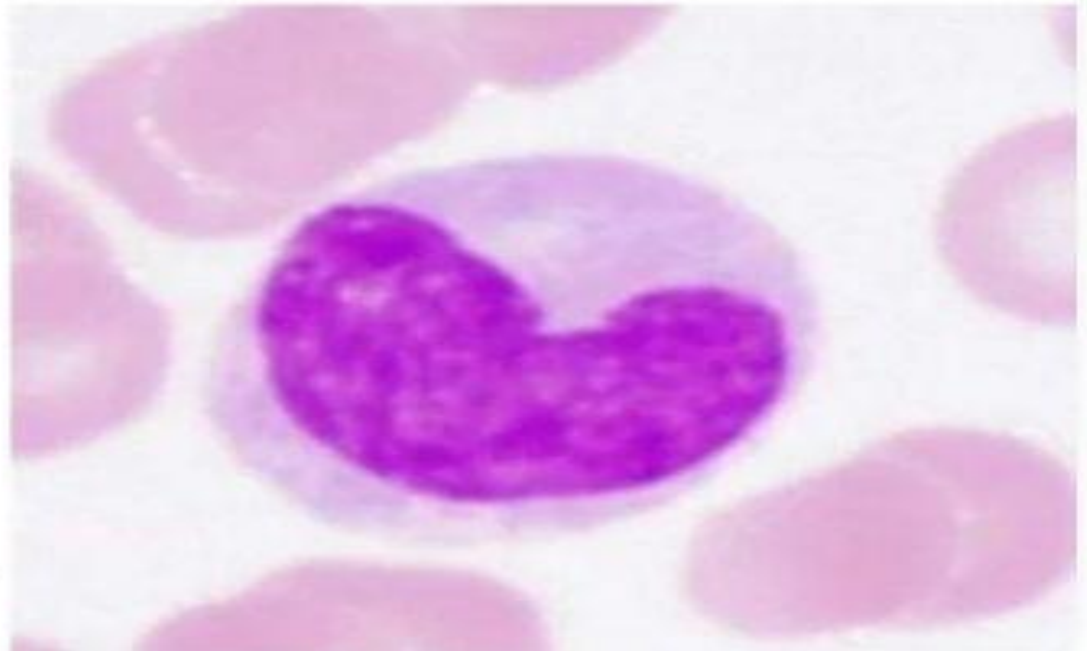
Function - phagocytosis, exit into tissues - tissue macrophages

4-8 % of all leucocytes

Are accumulated in the place of inflammation

A lot of lysosomal hydrolases

Aerobic pathway of energy obtaining prevails

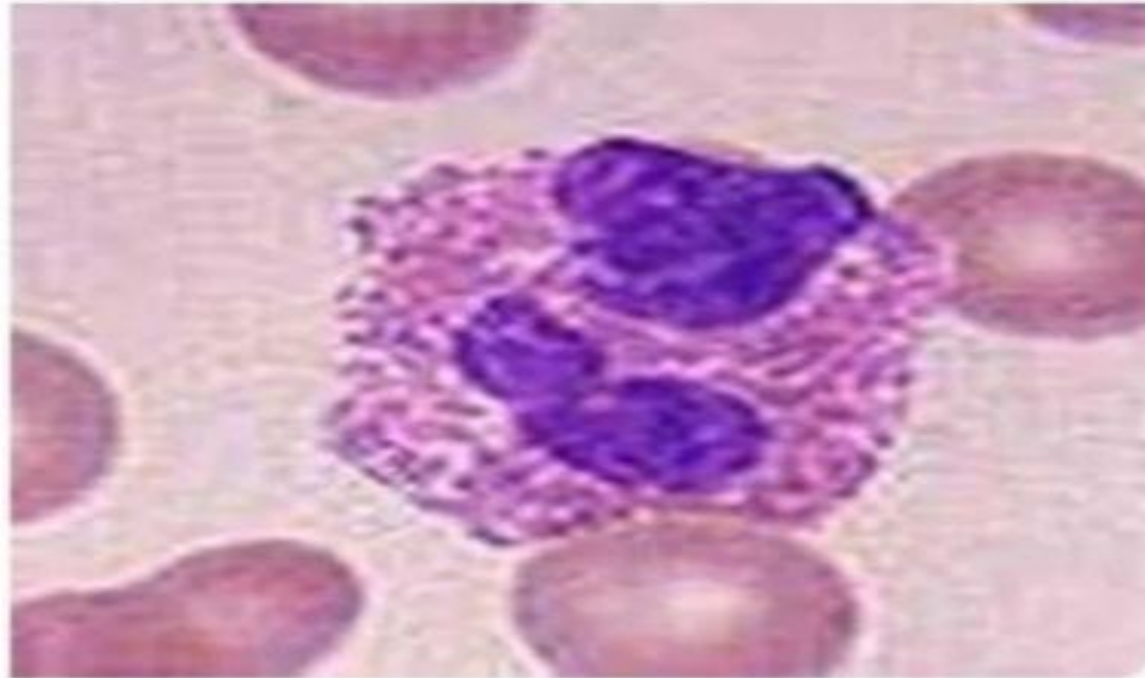


Eosinophils

Function - protection from microorganisms,
allergic reactions

3-6 % of all leucocytes

**Amount is
increased in
helminthosis,
organism
sensibilization,
alergy**



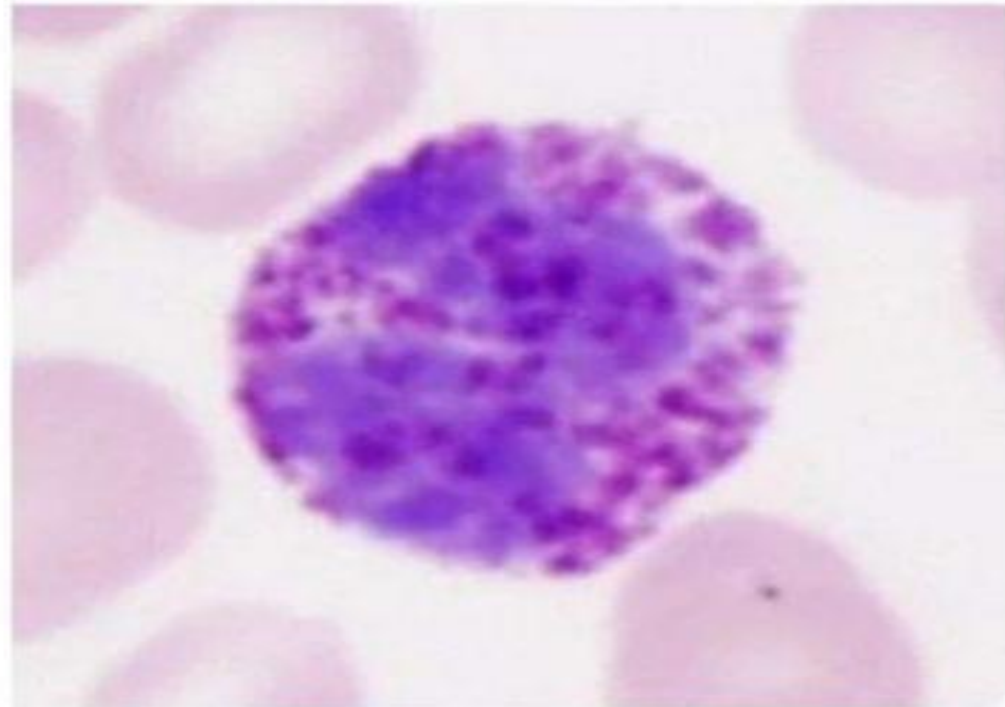
Basophils

Function - allergic reactions, blood clotting

1-5 % of all leucocytes

**Produce a lot of
histamine, serotonin,
heparin**

**Energy mainly from
oxidative
phosphorylation**



Neutrophils

Function - protection against infections

60-70% of all leucocytes

Main source of energy - glucose in glycolysis (small amount of mitochondria)

Hundreds of granules (contain hydrolyses, peroxidases, phosphatases, lysocim....)



HAEMATOPOIESIS

In normal healthy person there is a constant break down and new formation of cells, and the procedure of blood cells formation called Haematopoiesis.

NORMAL SITES OF BLOOD FORMAMATION

In adult: Main sites of haematopoiesis are the vertebrae, ribs, sternum, skull bones, pelvis, sacrum, and proximal ends of femur

Polycythemia : is an increased number of red blood cells in the blood.

In polycythemia, the levels of hemoglobin , hematocrit , or the red blood cell (RBC) count may be elevated when measured in the complete blood count (CBC), as compared to normal.

Hemoglobin levels greater than 16.5 g/dL in women and greater than 18.5 g/dL in men suggest polycythemia.

Polycythemia Primary Causes:

In primary polycythemia, inherent or acquired problems with red blood cell production lead to polycythemia. Two main conditions that belong to this category are polycythemia vera (PV) or polycythemia rubra vera [PRV].

1. **Polycythemia vera (PV):** is related to a genetic mutation in the JAK2 gene, which is thought to increase the sensitivity of bone marrow cells to Epo, resulting in increased red blood cell production. Levels of other types of blood cells (white blood cells and platelets) are also often increased in this condition.
2. **Primary familial and congenital polycythemia (PFCP):** is a condition related to a mutation in the EPOR gene and causes increased production of red blood cells in response to Epo.

Polycythemia Secondary Causes:

primary polycythemia in which overproduction of red blood cell results from increased sensitivity or responsiveness to Epo (often with lower than normal levels of Epo),

in secondary polycythemia, more red cells are produced because of high levels of circulating Epo.

The main reasons for higher than normal Epo are chronic hypoxia (poor blood oxygen levels over the long-term), poor oxygen delivery due to abnormal red blood cell structure, and tumors releasing incorrectly high amounts of Epo.

Some of the common conditions that can result in elevated erythropoietin due to chronic hypoxia or poor oxygen supply include:

1. chronic Obstructive Pulmonary Disease (COPD), emphysema, chronic bronchitis).
- 2- pulmonary hypertension.
- 3- hypoventilation syndrome.
- 4- congestive heart failure.
- 5- obstructive sleep apnea.
- 6- poor blood flow to the kidneys.
- 7- living in high altitudes.

❖ **Certain tumors** have a tendency to secrete inappropriately high amounts of Epo, leading to polycythemia. The common Epo-releasing tumors are:

- 1.liver cancer (hepatocellular carcinoma),
- 2.kidney cancer (renal cell carcinoma),
- 3.adrenal adenoma or adenocarcinoma, and uterine cancer.

Symptoms of polycythemia vera can be vague and quite general.

Some of the important symptoms include:

- 1- easy bruising.
- 2- easy bleeding.
- 3- blood clot formation (potentially leading to heart attacks, strokes.
- 4- blood clots in the lungs [pulmonary embolism].
- 5- bone and joint pain (hip pain or rib pain).
- 6- headache.
- 7- itching.
- 8- itching after taking a shower or bath (post-bath pruritus).
- 9- fatigue. 10- dizziness. 11- abdominal pain.

Diagnosis

In evaluating a patient with polycythemia, a complete medical history, physical examination, family history, and social and work-related history are very important.

In the physical exam, special attention may be paid to the heart and lung exam.

An enlarged spleen (splenomegaly) is one of the famous features of polycythemia vera; therefore, a careful abdominal exam to evaluate for an enlarged spleen is important.

Routine blood work including a complete blood count (**CBC**), **clotting profile**, and **metabolic panel** are basic components of laboratory tests in assessing the cause of polycythemia. Other typical tests to determine the potential causes of polycythemia include chest X-rays, electrocardiogram (ECG), echocardiogram, hemoglobin analysis, and carbon monoxide measurement.

Thank you