

## FORMED ELEMENTS OF BLOOD: STRUCTURE, FUNCTION, AND PHYSIOLOGICAL IMPORTANCE

**Asatullayev Rustamjon Baxtiyarovich**

*Trainee assistant at Samarkand State Medical University*

*Student: Ishankulov Javoxir Ergashevich*

Blood is a specialized fluid connective tissue that performs vital functions including gas transport, immune defense, thermoregulation, and maintenance of internal homeostasis. It consists of plasma and cellular components called the formed elements. Plasma represents approximately 55% of blood volume and is responsible for carrying dissolved substances, while the formed elements make up the remaining 45% and include erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets). These components originate primarily from hematopoietic stem cells in the red bone marrow through a regulated process known as hematopoiesis. Each group of formed elements possesses specialized structural and functional characteristics that ensure the efficient functioning of the cardiovascular and immune systems.

### Erythrocytes (Red Blood Cells)

Erythrocytes are the most abundant cellular component of blood, representing about 99% of the formed elements and approximately 4–6 million cells per microliter of blood. Mature erythrocytes lack a nucleus and most organelles, which allows them to maximize space for hemoglobin, the iron-containing protein responsible for oxygen transport. Their distinctive biconcave disc shape increases the surface area-to-volume ratio and enhances the diffusion of respiratory gases.

The primary function of erythrocytes is the transport of oxygen and carbon dioxide. Oxygen binds to iron ions in hemoglobin, while carbon dioxide is carried partly by hemoglobin and partly dissolved in plasma as bicarbonate ions. The regulation of erythrocyte production is controlled by the hormone erythropoietin, produced mainly in the kidneys in response to low oxygen levels.

The average lifespan of an erythrocyte is about 120 days. Aging cells become more fragile and are removed by macrophages in the spleen and liver. Disorders involving erythrocytes have systemic consequences: anemia occurs when there is insufficient hemoglobin or low erythrocyte count, leading to hypoxia, while polycythemia involves excessive erythrocyte production, increasing blood viscosity and cardiovascular strain. Thus, maintaining balanced erythropoiesis is essential for normal physiological functioning.

### Leukocytes (White Blood Cells)

Leukocytes constitute less than 1% of total blood volume but play an essential role in immune defense and tissue repair. Unlike erythrocytes, they contain nuclei and are capable of active movement, allowing them to migrate from blood vessels to infected or damaged tissues through a process called diapedesis. Leukocytes are classified into two major categories based on the presence of cytoplasmic granules:

#### 1. Granulocytes

These cells exhibit visible granules under the microscope and include:

Neutrophils – The most numerous leukocytes; specialized in phagocytosis of bacteria and primary responders in inflammation.

Eosinophils – Combat parasitic infections and modulate allergic reactions.

Basophils – Release histamine and heparin, promoting inflammation and preventing abnormal clot formation.

#### 2. Agranulocytes

These lack prominent granules and include:

Lymphocytes – Central to adaptive immunity; B lymphocytes produce antibodies while T lymphocytes destroy infected or malignant cells.

Monocytes – The largest leukocytes; differentiate into macrophages that perform phagocytosis and regulate immune responses.

Changes in leukocyte count are significant diagnostic indicators. Leukocytosis suggests infection or inflammation, whereas leukopenia may occur during immune suppression or bone marrow disorders. Pathological proliferation of leukocytes, such as in leukemia, disrupts normal blood function and can be life-threatening.

### Thrombocytes (Platelets)

Platelets are small, irregularly shaped cytoplasmic fragments derived from large precursor cells called megakaryocytes in the bone marrow. Despite being non-nucleated, they contain enzymes and granules necessary to perform a crucial role in hemostasis — the prevention of excessive blood loss.

When a blood vessel is damaged, platelets rapidly adhere to exposed collagen fibers, initiating the platelet plug formation. They release chemical mediators that recruit additional platelets and activate a complex coagulation cascade, ultimately resulting in the formation of a stable fibrin clot. After tissue repair, unnecessary clots are dissolved through fibrinolysis.

Disorders of platelet function can be dangerous. Thrombocytopenia, or reduced platelet count, increases the risk of internal and external bleeding, while thrombocytosis can cause

unwanted clot formation (thrombosis), potentially leading to stroke, myocardial infarction, or pulmonary embolism.

#### Integration of Formed Element Functions

Although erythrocytes, leukocytes, and platelets have distinct roles, the maintenance of health relies on their interaction. Oxygen transport by erythrocytes supports the metabolic activity of immune cells. Platelets release inflammatory mediators that attract leukocytes to injury sites. The immune system contributes to the safe removal of damaged erythrocytes. Any disruption in this balance can impact the entire organism.

Hematopoietic stem cells continuously replenish the formed elements, allowing the blood to adapt dynamically to physiological demands such as infection, hypoxia, dehydration, and physical trauma. The complex regulation of blood composition is therefore fundamental to survival.

#### Conclusion

The formed elements of blood — erythrocytes, leukocytes, and thrombocytes — are indispensable to the functioning of the human body. Red blood cells ensure oxygen delivery and carbon dioxide removal, white blood cells provide powerful defense against pathogens, and platelets protect the body from excessive blood loss. Together, they maintain homeostasis and support life-sustaining processes. A thorough understanding of their structure, function, and physiological interactions is essential for diagnosing and treating hematological and systemic diseases. The study of formed elements continues to play a critical role in modern clinical medicine, transfusion therapy, and biomedical research.