



## HEMATOPOIESIS– FORMATION OF BLOOD CELLS.

**Chorshanbiyev Otabek Panji O‘g‘li**

"Assistant at the Department of Medical Biology and Histology, Termiz Branch, Tashkent State Medical University."

[otabekchorshanbiyev@icloud.com](mailto:otabekchorshanbiyev@icloud.com)

**Bozorov Adham Anvar O‘g‘li**

"1st-year student at the Termiz Branch of Tashkent State Medical University."

[bozorovadham39@gmail.com](mailto:bozorovadham39@gmail.com)

### ANNOTATION

This scientific article analyzes hematopoiesis, the process of formation, development, and maturation of blood cells in the human body, from histological and physiological perspectives. The structure and functions of hematopoietic stem cells, their ability for self-renewal, and their differentiation into various blood cell lineages are described based on scientific literature. The article also discusses the role of the bone marrow microenvironment in hematopoiesis and provides detailed information about erythropoiesis, leukopoiesis, and thrombopoiesis. In addition, the contributions of prominent scientists who significantly advanced the study of hematopoiesis are briefly reviewed. Modern scientific studies show that hematopoietic stem cells possess the ability to self-renew and differentiate under the influence of cytokines and growth factors. The stromal microenvironment of the bone marrow also plays an important regulatory role in this process. This article aims to explain the theoretical foundations of hematopoiesis in the fields of histology, hematology, and medical biology, and it may serve as a useful scientific resource for medical students and researchers.

**Keywords:** Hematopoiesis, hematopoietic stem cells, bone marrow, erythropoiesis, leukopoiesis, thrombopoiesis, differentiation, cytokines, stromal microenvironment, multipotent cells.

### INTRODUCTION

Blood is one of the most important liquid connective tissues in the human body. It performs several essential functions, including transport, protection, regulation, and trophic support. Through blood circulation, oxygen, nutrients, hormones, and other biologically active substances are delivered to tissues and organs. At the same time, metabolic waste products are removed from the body through the blood.

Blood consists mainly of plasma and formed elements. The formed elements include erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets). These cells have a limited lifespan and are constantly replaced by newly formed cells. For example, erythrocytes live approximately **120 days**, while platelets circulate for about **7–10 days**. Because of this limited lifespan, the body requires a continuous process of blood cell production.

This process is known as hematopoiesis. Hematopoiesis is the formation and development of blood cells from hematopoietic stem cells. During embryonic development, hematopoiesis begins in the yolk sac. Later, the liver and spleen become the main sites of blood cell production. After birth, the primary site of hematopoiesis is the red bone marrow.

Modern scientific research shows that hematopoiesis is a complex biological process regulated by genetic and molecular mechanisms. Various growth factors, cytokines, and hormones influence the proliferation and differentiation of hematopoietic stem cells. Understanding the mechanisms of hematopoiesis is important for studying many hematological diseases and developing new treatment methods.



## MAIN PART

### **Hematopoietic Stem Cells.**

The central component of hematopoiesis is the hematopoietic stem cell (**HSC**). These cells possess two fundamental biological properties: self-renewal and multipotent differentiation. Self-renewal allows stem cells to maintain their population throughout life, while multipotency enables them to differentiate into various types of blood cells.

At the beginning of the twentieth century, the Russian scientist Alexander Maximow proposed the theory that all blood cells originate from a single common stem cell. Later, in the 1960s, Canadian researchers James Till and Ernest McCulloch experimentally confirmed this theory through laboratory studies. Their work provided strong evidence for the existence of hematopoietic stem cells.

Hematopoietic stem cells give rise to two major cell lineages: the myeloid lineage and the lymphoid lineage.

The myeloid lineage produces erythrocytes, granulocytes, monocytes, and platelets. The lymphoid lineage produces T lymphocytes, B lymphocytes, and natural killer (**NK**) cells. These cells play essential roles in oxygen transport, immune defense, and blood coagulation.

### **Erythropoiesis.**

Erythropoiesis is the process of red blood cell formation. This process mainly occurs in the red bone marrow and is regulated by the hormone erythropoietin. Erythropoietin is primarily produced in the kidneys in response to low oxygen levels in the blood.

The development of erythrocytes occurs through several stages. The first stage is the proerythroblast, which differentiates into a basophilic erythroblast. This cell then becomes a polychromatophilic erythroblast and later an orthochromatic erythroblast. During these stages, hemoglobin synthesis increases and the nucleus gradually condenses. Eventually, the nucleus is expelled from the cell, forming a reticulocyte. Reticulocytes enter the bloodstream and mature into fully developed erythrocytes within one or two days.

Erythrocytes are responsible for transporting oxygen from the lungs to body tissues and carrying carbon dioxide back to the lungs for removal.

### **Leukopoiesis.**

Leukopoiesis is the process of white blood cell formation. Leukocytes are essential components of the immune system and protect the body against infections and foreign substances.

Leukopoiesis results in the formation of granulocytes and agranulocytes. Granulocytes include neutrophils, eosinophils, and basophils, which play important roles in immune responses. The developmental stages of granulocytes include myeloblast, promyelocyte, myelocyte, metamyelocyte, and mature granulocyte.

Leukopoiesis is regulated by several cytokines and colony-stimulating factors. These molecules control the proliferation, differentiation, and activation of leukocyte precursors in the bone marrow.

### **Thrombopoiesis.**

Thrombopoiesis is the process of platelet formation. Platelets are small cytoplasmic fragments that play a crucial role in blood clotting and the prevention of bleeding.

Platelets are derived from large bone marrow cells known as megakaryocytes. Megakaryocytes undergo a process called endomitosis, during which their nucleus replicates without cell division, resulting in a very large cell with multiple copies of DNA. The cytoplasm of megakaryocytes then fragments to produce thousands of platelets that enter the bloodstream.

Platelets are essential for maintaining vascular integrity and initiating the process of hemostasis when blood vessels are damaged.



## CONCLUSION

In conclusion, hematopoiesis is a fundamental biological process that ensures the continuous production of blood cells throughout life. This process depends on the proliferation and differentiation of hematopoietic stem cells within the bone marrow microenvironment.

The normal functioning of hematopoiesis is essential for oxygen transport, immune defense, and blood coagulation. Disturbances in hematopoiesis can lead to various hematological disorders, including anemia, leukemia, and bone marrow failure.

Advances in modern biomedical research have significantly improved our understanding of the cellular and molecular mechanisms regulating hematopoiesis. Further studies of hematopoietic stem cells and bone marrow microenvironment may contribute to the development of new therapeutic approaches for treating hematological diseases.

## REFERENCES

1. Ross M.H., Pawlina W. *Histology: A Text and Atlas*. Wolters Kluwer, 2020.
2. Junqueira L.C., Carneiro J. *Basic Histology: Text and Atlas*. McGraw-Hill Education, 2018.
3. Gartner L.P., Hiatt J.L. *Color Textbook of Histology*. Elsevier, 2014.
4. Hoffbrand V., Moss P. *Essential Haematology*. Wiley-Blackwell, 2016.
5. Williams W.J., Beutler E., Lichtman M.A. *Williams Hematology*. McGraw-Hill, 2016.
6. Ahmedov A., Yuldashev B. *Histology, Cytology and Embryology*. Tashkent, 2018.
7. Rasulov S., Turaev X. *Human Anatomy and Physiology*. Tashkent, 2019.
8. Shodiyev E. *Medical Biology*. Tashkent, 2020.
9. Karimov Sh.I. *Fundamentals of Hematology*. Tashkent, 2017.
10. Rodak B.F., Fritsma G.A., Keohane E.M. *Hematology: Clinical Principles and Applications*. Elsevier, 2016.
11. Nathan D.G., Orkin S.H. *Nathan and Oski's Hematology and Oncology of Infancy and Childhood*. Elsevier, 2015.