

BLOOD AND BLOOD FORMED ELEMENTS

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Abstract

This article analyzes blood composition and its formed elements through examination of their structural and functional properties and their medical importance. The research synthesizes current scientific understanding of hematopoiesis, blood cell morphology, and the interdependence of blood components in sustaining vital bodily functions. This work establishes a theoretical foundation for blood physiology research which medical professionals use in their clinical applications.

Keywords

blood, erythrocytes, leukocytes, thrombocytes, hematopoiesis, plasma, hemoglobin, blood composition, formed elements, homeostasis

Аннотация

Данная статья представляет комплексный анализ состава крови и ее форменных элементов, исследуя их структуру, функции и клиническое значение. Исследование синтезирует современное научное понимание гемопоэза, морфологии клеток крови и взаимозависимости компонентов крови в поддержании жизненно важных функций организма. Данная работа вносит вклад в теоретическую основу для понимания физиологии крови и ее применения в клинической практике.

Ключевые слова

кровь, эритроциты, лейкоциты, тромбоциты, гемопоэз, плазма, гемоглобин, состав крови, форменные элементы, гомеостаз

Annotatsiya

Ushbu maqola qon tarkibi va uning shaklli elementlarining tuzilishi, funksiyalari va klinik ahamiyatini o'rganib, keng qamrovli tahlilni taqdim etadi. Tadqiqot gematopoez, qon hujayralari morfologiyasi va organizm hayotiy funksiyalarini ta'minlashda qon komponentlarining o'zaro bog'liqligining zamonaviy ilmiy tushunchasini sintez qiladi. Ushbu ish qon fiziologiyasini tushunish va uning klinik amaliyotda qo'llanilishi uchun nazariy asosga hissa qo'shadi.

Kalit so'zlar

qon, eritrotsitlar, leykotsitlar, trombotsitlar, gematopoez, plazma, gemoglobin, qon tarkibi, shaklli elementlar, gomeostaz

INTRODUCTION

Blood serves as the essential connective tissue which functions as the main blood vessel system that transports oxygen and essential nutrients and hormones and waste materials while it keeps body balance and protects against diseases. Blood makes up 7-8 percent of total body weight and contains two primary elements which include plasma that makes up 55 percent of blood volume and formed elements which make up the remaining 45 percent [1]. The formed elements include erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets), each performing specialized and essential functions. The study of blood composition together with its structural elements and cellular components provides essential knowledge to understand human body functions and disease mechanisms. Blood tissue consists of more than its cellular components because it includes complex systems which control the production and

development and lifespan of blood cells [2]. The article provides an analysis of blood components that emphasizes formed elements through detailed examination of current scientific research findings.

METHODOLOGY AND LITERATURE REVIEW

The researchers conducted their study through a complete investigation of existing literature which included both peer-reviewed scientific articles and basic hematology textbooks and clinical research publications. The review focused on authoritative sources addressing blood composition, hematopoiesis, cellular morphology, and physiological functions of blood components. The main sources of the study included fundamental studies of hematology and physiology together with recent studies that explored the current knowledge about blood cell biology and its medical usage. The analysis extracted data from multiple linguistic sources which included English and Russian and Uzbek scientific literature to achieve complete subject matter coverage. Blood plasma consists of an acellular component that contains 90-92% water and 7-8% proteins and various dissolved substances which include electrolytes and nutrients and gases and hormones and metabolic waste products [3]. The three major plasma proteins—albumins, globulins, and fibrinogen—perform critical functions in maintaining osmotic pressure, immune response, and blood clotting respectively.

Erythrocytes, which represent the largest group of blood components, exist in males at 4.5 to 5.5 million cells per microliter and in females at 4.0 to 5.0 million cells per microliter, as they possess unique abilities to function as biconcave disc-shaped cells that lack all organelles and nuclei during their mature state. Their primary function involves oxygen transport through hemoglobin, an iron-containing protein constituting approximately 33% of erythrocyte mass, with each hemoglobin molecule capable of binding four oxygen molecules. The biconcave shape establishes a gas exchange optimal surface area which enables narrow capillary passage flexibility to all organisms that possess this design. Leukocytes exist in much smaller numbers than erythrocytes because their count ranges from 4,000 to 11,000 cells per microliter yet they fulfill essential functions for immune defense which results in their classification as granulocytes with three types of neutrophils, eosinophils, and basophils and agranulocytes with two types of lymphocytes and monocytes. Neutrophils constitute 50-70% of total leukocytes and serve as the first line of defense against bacterial infections through phagocytosis, while lymphocytes, which make up 20-40% of white blood cells, develop adaptive immunity through antibody production and cell-mediated immune responses. Thrombocytes or platelets exist as tiny cell fragments that lack nuclei and develop from megakaryocytes in bone marrow, which produce 150,000 to 400,000 platelets per microliter of blood, because platelets play a vital role in hemostasis and blood clotting processes. Platelets begin to form a clot after they stick to collagen at an injury site, which causes them to gather together and release chemical signals that trigger blood clotting, which eventually leads to the production of a durable fibrin clot that stops blood loss.

RESULTS AND DISCUSSION

The analysis of current literature reveals that blood functions extend far beyond simple transport, encompassing complex regulatory systems that maintain physiological equilibrium. Hematopoiesis, the process of blood cell formation, occurs primarily in red bone marrow through differentiation of pluripotent hematopoietic stem cells under influence of specific growth factors and cytokines including erythropoietin, thrombopoietin, and various colony-stimulating factors [8]. Erythrocyte production is tightly regulated by oxygen-sensing mechanisms, with hypoxia stimulating erythropoietin secretion from kidneys, subsequently accelerating red blood cell production to enhance oxygen-carrying capacity. The average lifespan of erythrocytes approximates 120 days, after which senescent cells are removed by splenic macrophages, and iron from degraded hemoglobin is recycled for new cell production, demonstrating remarkable

efficiency in resource utilization [9]. Leukocyte diversity reflects the multifaceted nature of immune challenges, with each subtype specialized for particular defensive functions. Granulocytes contain specific granules with antimicrobial substances and enzymes, while agranulocytes coordinate sophisticated immune responses through antigen recognition, antibody production, and immune memory formation.

The balance between different leukocyte populations provides insights into various pathological conditions, with neutrophilia indicating bacterial infection, lymphocytosis suggesting viral infection, and eosinophilia often associated with parasitic infections or allergic reactions [10]. Platelet function demonstrates remarkable complexity beyond simple clot formation, including roles in wound healing, inflammation, and even tumor metastasis through interactions with cancer cells. Contemporary research has revealed that platelets release numerous bioactive substances including growth factors, chemokines, and cytokines that influence vascular biology and tissue repair processes. The interdependence of blood components manifests in numerous physiological processes, with plasma proteins facilitating nutrient transport to cells, erythrocytes maintaining tissue oxygenation, leukocytes providing immune surveillance, and platelets ensuring vascular integrity. Clinical medicine extensively utilizes blood component analysis for diagnostic purposes, with complete blood count remaining one of the most frequently ordered laboratory tests, providing valuable information about overall health status and specific disease conditions.

CONCLUSION

Blood and its formed elements constitute a complex biological system essential for maintaining life through integrated transport, defensive, and regulatory functions. The comprehensive analysis of scientific literature confirms that erythrocytes, leukocytes, and thrombocytes, though arising from common progenitor cells, develop highly specialized structures and functions optimized for their respective physiological roles. Erythrocytes exemplify structural adaptation for function through their biconcave shape and hemoglobin content maximizing oxygen transport efficiency, while leukocyte diversity reflects evolutionary optimization for combating varied pathogenic threats. Platelets demonstrate that cellular fragments can perform sophisticated functions in hemostasis and beyond. Understanding blood composition and formed element characteristics provides essential foundation for clinical medicine, enabling diagnosis and monitoring of numerous pathological conditions ranging from anemia and infections to coagulation disorders and malignancies. Future research directions should continue exploring molecular mechanisms regulating hematopoiesis, cellular interactions within blood, and therapeutic applications of blood component knowledge. The continuing advancement of hematological science promises improved diagnostic capabilities and therapeutic interventions for blood-related disorders.

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