PLATELETS, BLOOD GROUPS, AND RH FACTOR: BIOLOGICAL AND MEDICAL PERSPECTIVES

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Abstract. *This article discusses the biological and clinical significance of platelets, blood groups, and the Rh (Rhesus) factor in human physiology and transfusion medicine. It reviews the structure and functions of platelets in hemostasis, the classification of the ABO blood group system, and the immunological basis of the Rh factor. Special attention is given to the genetic mechanisms of inheritance, the compatibility of blood types in transfusion, and the role of platelet and Rh analysis in preventing hemolytic disease of the newborn. The study integrates modern research findings and WHO medical guidelines to highlight the importance of safe transfusion practices and personalized medicine.*[1]

Keywords: *platelets, blood groups, Rh factor, hemostasis, immunohematology, transfusion, erythrocytes, genetic inheritance.*

Introduction. The study of blood and its cellular components has been one of the central pillars of medical science.[2] Blood not only serves as a vital transport medium but also plays a key role in immune defense, oxygen delivery, and tissue repair.[3] Among its components, platelets (thrombocytes), blood group antigens, and the Rh factor are of particular clinical and biological importance.[4]

Accurate knowledge of these elements is essential in transfusion medicine, surgery, obstetrics, and hematology.[5] Understanding their interactions and

compatibility ensures the prevention of life-threatening immune reactions and supports advances in regenerative and personalized medicine.

Structure and Function of Platelets. Platelets, or thrombocytes, are small, non-nucleated cell fragments derived from megakaryocytes in the bone marrow.[6] They play a fundamental role in hemostasis, the process that prevents and stops bleeding. When a blood vessel is injured, platelets adhere to the damaged site, aggregate, and release bioactive substances such as serotonin, ADP, and thromboxane A_2, initiating the formation of a hemostatic plug.[7]

Normal platelet count in human blood ranges from 150,000 to 450,000 per microliter.[8] Low platelet count (thrombocytopenia) can lead to bleeding disorders, while excessive platelet activity (thrombocytosis) may cause thrombotic complications such as stroke or myocardial infarction.[9]

ABO Blood Group System. The ABO system, discovered by Karl Landsteiner in 1901, classifies human blood into four main types: A, B, AB, and O, based on the presence or absence of A and B antigens on the surface of red blood cells.[10]

Compatibility between donor and recipient blood types is crucial to prevent hemolytic transfusion reactions, which occur when incompatible antibodies destroy foreign red blood cells.[11]

The distribution of blood groups varies across populations: globally, type O is the most common, while type AB is the rarest. In Uzbekistan, as in many Eurasian populations, types A and O are predominant.[6]

Rh (Rhesus) Factor and Its Clinical Importance. The Rh factor, discovered in 1940 by Landsteiner and Wiener, is another antigen found on the surface of red blood cells, most commonly the D antigen.[7] Individuals with the D antigen are Rh-positive (Rh^+), while those without it are Rh-negative (Rh^-). Approximately 85% of the world's population is Rh-positive.[8]

Rh incompatibility becomes clinically significant in transfusion and pregnancy. When an Rh-negative mother carries an Rh-positive fetus, fetal red cells may enter the maternal bloodstream, triggering the production of anti-D antibodies.[9]

In subsequent pregnancies, these antibodies can cross the placenta and destroy fetal red cells, causing hemolytic disease of the newborn (HDN).[10]

To prevent this condition, Rh-negative mothers are given anti-D immunoglobulin (RhoGAM) within 72 hours after childbirth or miscarriage, effectively suppressing antibody formation.[11]

Integration of Platelet Function and Blood Compatibility. In modern medicine, platelet transfusion and blood group matching are performed using advanced immunohematological testing. Platelet transfusions are indicated for patients with severe bleeding, leukemia, or after chemotherapy. Compatibility testing ensures that donor platelets and plasma antibodies do not provoke immune reactions in recipients.[5]

Recent studies have explored the genetic relationship between ABO and Rh systems and their influence on thrombotic diseases. Research suggests that individuals with blood group A may have a slightly higher risk of cardiovascular complications, possibly due to variations in clotting factor activity.[8]

Conclusion. Understanding the biology of platelets, blood groups, and Rh factor remains fundamental to safe clinical practice and medical innovation. These components are not only vital for maintaining homeostasis but also serve as indicators of genetic and immunological diversity.

The continuous improvement of laboratory diagnostics, genetic screening, and transfusion protocols ensures that medicine can provide individualized, safe, and effective care. In this sense, the science of blood is both a reflection of human biology and a cornerstone of modern health systems.

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