AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

# ABO ANTIGEN SYSTEMS AND THEIR CLINICAL SIGNIFICANCE. ERRORS ENCOUNTERED IN TRANSFUSION SAFETY AND THEIR PREVENTION

**Turdiqulova Gulchehra Berdiqul kizi**
2nd-year student, Karshi State University
turdiqulovagulchehra48@gmail.com

**Kholmurodov Asqar Bekmurodovich**
Lecturer of Microbiology, Immunology and Virology
Karshi State University

**Abstract:** Transplantology and transfusiology are closely interconnected fields. Transplantology deals with the transplantation of organs and tissues, whereas transfusiology focuses on the correct use of blood and blood substitutes. Their interrelation lies in the transfer of tissues from one organism to another. The transfusion of blood and its components (erythrocytes, leukocytes, thrombocytes, formed elements of blood, and plasma) is called hemotransfusion.

**Keywords:** Transfusion, isoagglutination, ABO antigen system, Rh factor, erythrocyte enzyme groups, anaphylactic reaction, thromboembolism.

Main Text. The process of isohemagglutination was discovered in 1901 by Landsteiner. This phenomenon is not pathological but physiological. Isohemagglutination occurs as a result of the interaction between agglutinins in the blood serum and agglutinogens on erythrocytes. For example, when agglutinogen A meets agglutinin α, or agglutinogen B meets agglutinin β, erythrocytes clump together. Based on the properties of erythrocytes and serum in different blood groups, human blood is classified into groups. Currently, more than 250 erythrocyte antigens forming over 20 antigen systems are known. ABO Antigen System. The ABO system is the primary serological system that determines the compatibility of donor and recipient blood during transfusion. It consists of two genetic determinants—A and B agglutinogens (antigens)—and two agglutinins—α and β (antibodies). Agglutinogens A and B are located on the erythrocyte membrane, whereas agglutinins α and β are found in the blood serum. Agglutinin α is an antibody against antigen A, and agglutinin β is an antibody against antigen B. A person cannot have agglutinogens and agglutinins of the same name simultaneously.

When identical antigens and antibodies interact, an isohemagglutination reaction occurs, which determines blood incompatibility during hemotransfusion.

According to the compatibility of erythrocyte antigens A and B and serum antibodies α and β, humans are divided into four blood groups:

- Group O (I): No agglutinogens on erythrocytes; serum contains α and β agglutinins
- Group A (II): Erythrocytes contain A agglutinogen; serum contains β agglutinin
- Group B (III): Erythrocytes contain B agglutinogen; serum contains α agglutinin
- Group AB (IV): Erythrocytes contain both A and B agglutinogens; serum contains no agglutinins

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

Recently, subtypes of classical A and B antigens and other antigens have been identified.

Subtypes of Antigen A. Antigen A has two subtypes: $A_1$ and $A_2$. Agglutination occurs more frequently with $A_1$ erythrocytes (about 88%) compared to $A_2$ (12%). Therefore, $A_1$ is commonly designated simply as A, while $A_2$ is indicated with a subscript. Accordingly, blood group A (II) includes A (II) and $A_2$ (II).

Rh (Rhesus) Factor. Iso-serological studies have shown the presence of various antigens on human erythrocytes (e.g., N, P, etc.), though their clinical significance is limited.

In 1939, American scientist Wiener discovered a new antigen using serum from rabbits immunized with rhesus monkey erythrocytes, which he named the Rh factor. In 1940, Landsteiner further studied this antigen. The Rh factor is independent of the ABO system, age, and sex. Approximately 85% of people are Rh-positive ($Rh^+$), while 15% are Rh-negative ($Rh^-$). The Rh antigen system consists of six antigens, inherited genetically: Rh(D), Rh(C), and Rh(E)Rh incompatibility occurs when Rh-positive blood is transfused into an Rh-negative recipient or when an Rh-negative pregnant woman carries an Rh-positive fetus. In the first case, post-transfusion reactions may occur due to iso-sensitization; in the second, pregnancy complications such as hemolytic disease of the newborn may develop. Transfusion Errors and Their Prevention Transfusion of ABO-incompatible blood can lead to fatal intravascular hemolysis. Most transfusion errors occur due to human factors and may arise at any stage of the transfusion chain—from blood sampling and labeling to administration.

Approximately 50% of errors originate in hospital blood banks. Critical control points include:

1. Transfusion laboratories, which filter mislabeled samples using reliable IT systems.
2. Bedside verification, where accurate patient identification is essential.

Prevention strategies include continuous staff training and implementation of modern technologies such as barcode-based patient identification systems, which significantly reduce transfusion errors.

Erythrocyte Enzyme Groups

Since 1963, numerous genetically polymorphic enzyme systems have been identified in human erythrocytes, including phosphoglucomutase, adenosine deaminase, glutamate-pyruvate transaminase, esterase-D, and others.

Complications of Blood Transfusion

If transfusion rules are violated, various complications may occur:

Transfusion Reactions

- Mild: Slight fever, headache, weakness
- Moderate: Fever up to 2°C, tachycardia, urticaria

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

- Severe: High fever, chills, cyanosis, dyspnea, angioedema

Types include pyrogenic, antigenic, allergic, and anaphylactic reactions.

Thromboembolism

Caused by blood clot migration, potentially leading to pulmonary infarction. Prevention includes proper blood preparation and use of microfilters.

Cardiovascular Overload

Rapid transfusion may cause heart failure, especially in patients with cardiac disease. Slow transfusion and warming blood to 37°C are recommended.

Potassium Toxicity

Stored blood may contain high potassium levels. Prevention includes using fresh erythrocyte mass and calcium chloride.

**Conclusion**

Blood plays a vital biological role and cannot be fully replaced by artificial fluids. However, blood substitutes are used to restore specific therapeutic functions, such as in shock, acute blood loss, burns, surgeries, poisoning, and metabolic disorders.

Blood substitutes are classified into:

- Hemodynamic solutions (e.g., polyglucin, reopolyglucin)
- Detoxification solutions
- Parenteral nutrition solutions

Modern plasma substitutes, also called hemocorrectors, help regulate water-electrolyte and acid-base balance. These solutions must be physiologically compatible, non-toxic, non-pyrogenic, sterile, and safe

**References:**

1. Editor Aleksandar Mijovich Haematology King's College Hospital London, UK.or Transfusion Medicine Case Studies and Clinical Management .Second Edition.2ndedition: © The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023.
2. Counts RB, Haisch C, Simon TL, Maxwell NG, Heimbach DM, Carrico CJ.

Hemostasis in massively transfused trauma patients. Ann Surg. 1979 Jul;190(1):91-9. [PMC free article] [PubMed].

AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

3. TRANSFUZIOLOGIYA ASORATLARI VA ULARNI DAVOLASH D.A.Qirg'izbayeva A.Akbarov X.X. Qirg'izbayev Namangan Davlat universiteti, Uychi ko'cha, 100125 Tashkent, Uzbekistan Тел: +998 99 834-89-97 e-mail: kirgizbayev.husniddin@gmail.com https://doi.org/10.5281/zenodo.11171113

4. K.M ABDIYEV,U .D .DADAJONOV,A.G.MADASHEVA. Qon va qon komponentlari transfuziyasi. Qonni o'rnini bosuvchi eritmalar. Tibbiyot oliy o'quv yurtlarining magistratura, klinik ordinatura va internatura rezidentlari uchun o'quv qo'llanma Toshkent 2022 yil "QAMAR MEDIA"., 2022

6.Toshkent tibbiyot akademiyasi http://gps.med.tma.uz OXUNOV .A.O.

"Qon va qon o'rnini bosadigan suyuqliklarni quyish".

DASTURLANGAN ELEKTRON O'QUV QO'LLANMA.