

The MAL Blood Group System: Discovery, Characteristics, and Clinical Implications Mini Review

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ABSTRACT

Article history:

Submitted: November 15, 2024

Revised : November 30, 2024

Accepted: December 16, 2024

Keywords: MAL Blood group, Rare blood group, complications, new antigen

The inherited AnWj-negative blood group phenotype is caused by homozygosity for a deletion in MAL, encoding Myelin and lymphocyte protein. Mal protein is expressed on red blood cell membranes of AnWj-positive, but not AnWj-negative, individuals. The 50-year-old enigma has been resolved with the discovery of a new blood group, MAL. Researchers from the University of Bristol, NHSBT's International Blood type Reference Laboratory (IBGRL), and NHS Blood and Transplant (Bristol) have determined the genetic foundation of the previously reported but enigmatic AnWj blood type antigen. The results make it possible to identify and treat rare patients who do not have this blood group. This mini review highlights on recent discovery of MAL blood group system after 50 years, to avoid transfusion reactions in the patients.

INTRODUCTION

Blood types are intricate. The ABO and Rh blood group systems are the two most well-known. Red blood cells may carry antigens, which are surface indicators, within each blood type. (1) People with A blood have the A antigen, people with B blood have the B antigen, individuals with AB blood have both, and people with O blood have none of the antigens, according to the ABO blood group system. More than 360 known blood antigens are present in the 47 recognized blood group systems.

According to recent study, the AnWj antigen, which was identified in 1972 but whose genetic origin was previously unknown, is located in the new blood group system MAL, which is headed by specialists from NHS Blood and Transplant (2). The recent finding makes it possible to identify and treat uncommon patients who do not belong to this blood group. Only a small number of persons have been identified to have the rare hereditary variant of the AnWj-negative phenotype. Some people may not have the MAL blood group as a result of illness. (2,3)

AnWj-negative persons may experience a transfusion reaction if they receive AnWj-positive blood; this finding enables the development of new genotyping tests to identify these uncommon individuals and lower the risk of complications related to transfusion. In the AnWj-positive population, which makes up over 99.9% of the population, full-length Mal protein has been demonstrated to be expressed on red blood cells; AnWj-negative individuals' cells do not produce this protein. (2,4)

The hereditary AnWj-negative phenotype was linked to homozygous deletions in the MAL gene, according to the researchers. The most common causes of AnWj-negative status includes

hematological disorders and some cancers that inhibit the expression of antigens. There is a very small population that is genetically AnWj negative. Five individuals, including an Arab- Israeli family, were found to be genetically AnWj negative in a recent study.

The purpose of this article is to review the discovery of the MAL blood group system, which was identified as a source of AnWj antigens whose genetic origin was previously unknown. This discovery opens up opportunities to identify individuals with the rare AnWj negative blood group and provides a better understanding of the risk of transfusion in patients with this blood group. This article also aims to discuss the impact of this discovery on blood transfusion practices, especially to prevent transfusion reactions in patients with this very rare blood type.

RESEARCH METHODS

This article uses a literature review approach to explore the latest discoveries about the MAL blood group system and its relationship to the AnWj antigen. The main data sources are taken from studies published by researchers from the University of Bristol, NHS Blood and Transplant, and international reference laboratories for blood groups. The main focus of this article is on the genetic recognition of the AnWj-negative blood type, understanding the basic genetic mechanisms of the MAL blood type, and its implications for blood transfusion safety and the management of patients with this rare blood type.

RESULTS AND DISCUSSION

The significance of blood types

Transfusions: Knowledge of blood groups is crucial for ensuring safe blood transfusions. Each blood group has different antigens on the surface of red blood cells, and if mismatched blood is transfused into a patient, an immune reaction can occur. This reaction can be very dangerous and even life-threatening. For example, if a person with blood type A receives blood from a type B donor, their immune system will recognize the B antigens as foreign and initiate an immune response that destroys red blood cells, known as a hemolytic reaction. Therefore, matching the donor's and recipient's blood type is essential before performing a transfusion to prevent these harmful reactions.

Pregnancy: Blood group compatibility between the mother and fetus, particularly concerning the Rh factor, can impact pregnancy. Rh is an antigen found on red blood cells. If a mother is Rh-negative (lacking the Rh antigen) and the fetus inherits Rh-positive blood from the father, Rh incompatibility can occur. This incompatibility can cause problems during pregnancy, such as hemolytic disease of the newborn (HDN), where the mother's immune system produces antibodies against the Rh-positive blood of the fetus, destroying the fetus's red blood cells and causing anemia. To prevent this, Rh-negative mothers are typically given an injection of anti-D immunoglobulin during pregnancy or after childbirth to prevent the development of antibodies against Rh-positive blood.

Forensics and Paternity Testing: Blood typing also has applications in forensics and paternity testing. In forensic investigations, blood type found at a crime scene, such as in blood or other bodily fluids, can help identify a person or link an individual to a crime scene. For instance, the blood type found at the scene can be compared with that of a victim or suspect. In paternity testing, blood typing can be used to compare the blood type of a child with that of the suspected parents, helping identify biological relationships. If the child's blood type does not match one of the parents, it can indicate that the individual is not the biological parent of the child. Blood typing can be used in forensic investigations and paternity testing(5)

Overall, blood types play a crucial role in various medical and legal contexts, ensuring safe blood transfusions, supporting healthy pregnancies, and assisting in forensic investigations and paternity testing. Proper knowledge of blood types can prevent various medical complications and provide valuable information in legal and criminal contexts.

Different blood group systems exist, and they are all identified by particular antigens found on the surface of red blood cells. The following are the main blood group systems:

1. The American Blood Group System (ABO)

Type A: A antigens present; anti-B antibodies in plasma.

Type B: plasma contains anti-A antibodies and B antigens.

Type AB: Both A and B antigens present; no antibodies (universal receiver).

Type O: Anti-A and anti-B antibodies (universal donor); neither A nor B antigens.

2. Rh Blood Group System: Rh-positive (Rh⁺): Rh (D) antigen is present.

Rh-negative (Rh⁻): The antigen Rh (D) is absent.

3. The MNS Blood Group System

4. Blood Group System Kell

Has variations of the K antigen, or Kell. The Kell system is significant in transfusion medicine and can cause hemolytic disease of the newborn.

5. Duffy Blood Group System

Includes Fya and Fyb antigens. There is a connection between this system and vulnerability to specific illnesses, like malaria.

6. Kidd Blood Group System

Consists of Jka and Jkb antigens. Hemolytic transfusion reactions that are delayed may have an impact on the Kidd system.

7. Lewis Blood Group System

Plasma contains Lewis antigens (Lea and Leb), which are not generated by red blood cells. In transfusion, they are crucial.

8. P Blood Group System: This system uses the P1 antigen and is linked to an increased risk of contracting infections and developing specific illnesses.(6,7)

The MAL Blood Group System's Discovery

One of the less well-known blood group systems is the MAL blood group system, which is mainly distinguished by certain antigens present on the surface of red blood cells.

Overview of the MAL Blood Group System

The MAL antigen, of which MAL1 is the principal antigen of interest, is what defines the MAL blood group system. While there may be other antigens associated with this system, MAL1 is the most important.

The MAL gene, found on chromosome 3, encodes the antigens of the MAL blood group system. Different people will exhibit different phenotypes due to variations in the gene's expression. People are categorized as MAL negative (not containing the MAL1 antigen) or MAL positive (containing the MAL1 antigen). These traits can differ in frequency among various ethnic and population groups.(3,8)

The MAL blood group system is relevant in organ transplantation and transfusion therapy, even though it is not frequently linked to serious clinical problems like the ABO or Rh systems. To lower the danger of transfusion responses, compatibility testing may take MAL antigens into account or not. Compatibility testing is necessary prior to blood transfusions, just like it is for other blood types. The presence of MAL antigens can alter the selection of donor blood, particularly in patients who may

have developed antibodies against the MAL antigen. Research on the MAL blood group system is still underway, especially in relation to its implications for transfusion protocols and its function in disease susceptibility.(9,10) Studies have looked into the possible connections between MAL antigens and a range of illnesses, but further investigation is required to completely comprehend these relationships.

CONCLUSION

Although it is not as well-known as other blood group systems, the MAL blood group system contributes to the complexity of human blood typing. Comprehending it holds significance in various therapeutic situations, especially in guaranteeing secure blood transfusions and overseeing patient treatment. The MAL blood group system's ramifications in transfusion medicine and other medical contexts may become increasingly pertinent as research advances. Based on the presence of certain antigens on the surface of red blood cells, blood is categorized according to the MAL blood group system.

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