

Rh (rhesus) FACTOR

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ABSTRACT:-

This abstract provides an overview of the Rhesus factor, its history, genetic basis, clinical significance, and current research trends. The presence or absence of the Rh antigen determines an individual's Rh blood type, which can be positive or negative. Rh positive individuals have the antigen, while Rh negative lack it. Incompatibility between Rh factor of pregnant women and her fetus can lead to hemolytic diseases of the newborn, a potentially life-threatening condition.

KEY WORDS:-

Blood group, Rh incompatibility, Rh isoimmunisation, Pregnancy, Hemolysis.

INTRODUCTION:-

Blood group also called as a blood type. Classification of blood group is based on the presence or absence of inherited antigenic substances on the surfaces of red blood cells (RBCs). These antigens may be proteins, glycoproteins, or glycolipids, depending on the blood group system.⁽¹⁾

Blood groups are of two types:-

- ABO System.
- Rh System.

ABO Blood Grouping System:-

An individual's blood is commonly classified into one of the four main groups (A, B, AB, and O). The surface of an individual's red blood cells contains a number of proteins known as individual-specific antigens.

Many blood antigens have been identified, but the antigens A, B, and Rh are the most important in determining blood group or type. Due to their ability to induce the clumping of blood cells, antigens are alternatively termed agglutinogens.

Karl Landsteiner is credited with the invention of the ABO blood grouping device in 1901.

Adriano Sturli and Alfred Von Decastello who were working under Landsteiner discovered type AB a year later in 1902. Landsteiner was awarded the 1930 Nobel Prize in Physiology or Medicine for his work. Jansky is credited with the primary

classifications of blood into the 4 types (A,B,AB,O) in 1907, which stays in today.⁽²⁾

Rank	Blood type	Percentage of the blood type
1.	O+	42%
2.	A+	31%
3.	B+	15%
4.	AB+	5%
5.	O-	3%
6.	A-	2.50%
7.	B-	1%

Rh Blood Grouping System:-

"The crucial red blood cell membrane antigen in question is the Rhesus (Rh) antigen, also referred to as the Rhesus factor."

. About 85% of people have this antigen; they are Rhesus positive (Rh+) and not therefore make anti-Rhesus antibodies. The remaining 15% have no Rhesus antigen (they are Rhesus negative, or Rh-) Rh- individuals are capable of making anti Rhesus antibodies, but are stimulated to do so only in certain circumstances, e.g. in pregnancy, or as the result of an incompatible blood transfusion.

The time period Rh blood organization machine refers back to the 5 important Rhesus antigens (C, c, D, d, E and e) in addition to the various different much less common Rhesus antigens.

Blood groups and disease association:-

The ABO blood groups have a profound influence on haemostasis.⁽³⁾ They exert major quantitative effects on plasma levels of von Willebrand factor and factor VIII. Increased association of myocardial infarction, ischemic stroke, and venous thromboembolism is seen with blood groups A and AB⁽⁴⁾ possibly through functional ABO glycol transferases modulation of thrombosis. A higher risk cerebral venous thrombosis has been reported in non-O groups.⁽⁵⁾ Significant association of ABO groups with the prevalence of preeclampsia has been reported, where AB group was found to be associated with an increased risk of

2.1- folds.⁽⁶⁾Preliminary studies suggested an association of ABO system with malignancies. A positive correlation has been shown between blood group A with chronic hepatitis-B infection and pancreatic cancer;⁽⁷⁾ and blood group B with ovarian cancer.⁽⁸⁾Protection against falciparum malaria can be finished with group O by reducing rosette formation.⁽⁹⁾Blood group O increases the severity of contamination in *Vibrio cholerae* strains.

Rh(Rhesus) Factor:-

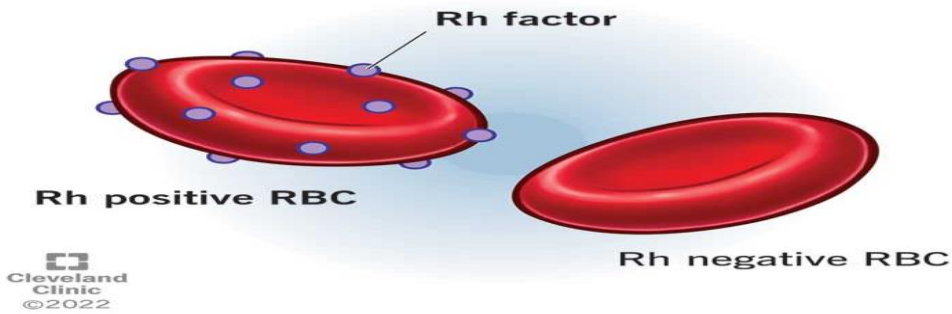
The Rh factor, an inherited antigen found in human blood, distinguishes blood as either Rh-positive or Rh-negative. Naturally, Rh blood lacks Rh antibodies. However, if Rh-positive blood is introduced into an Rh-negative individual, they produce Rh antibodies. Subsequent transfusions of Rh-positive blood can provoke severe reactions, including red blood cell clumping and hemolysis. The Rh blood group system encompasses 50 distinct blood group antigens, six of which are prevalent Rh antigens, each termed an Rh factor.

These types are designated C,D,E and c, d, and e. The type D antigen is widely prevalent in the population considerably more antigenic than the other Rh antigens. Anyone who has this type of antigen is said to be Rh positive, whereas a person who does not have type D antigen is said to be Rh negative. This antigen was discovered by Karl Landsteiner and Alexander Weiner in 1940. It was first discovered in Rhesus macaque and hence the name 'Rh factor'.

The Rh protein consists Rh antigen however are most effectively expressed at the erythrocyte surface if RhAG is likewise present. The amino acid sequence homology (approximately 40%) of the RhAG proteins indicates an ancestral relationship, and collectively they are referred to as the Rh protein family. Hydrophobicity profiles, immunochemical analyses, and data obtained through site-directed mutagenesis imply that Rh and RhAG proteins have 12 transmembrane spans with both the N-terminus and C-terminus oriented to the cytoplasm.⁽¹⁰⁾

Rh factor
Rh factor (or Rhesus factor) is a type of protein on the outside of your red blood cells (RBCs)

X



Rh incompatibility:-

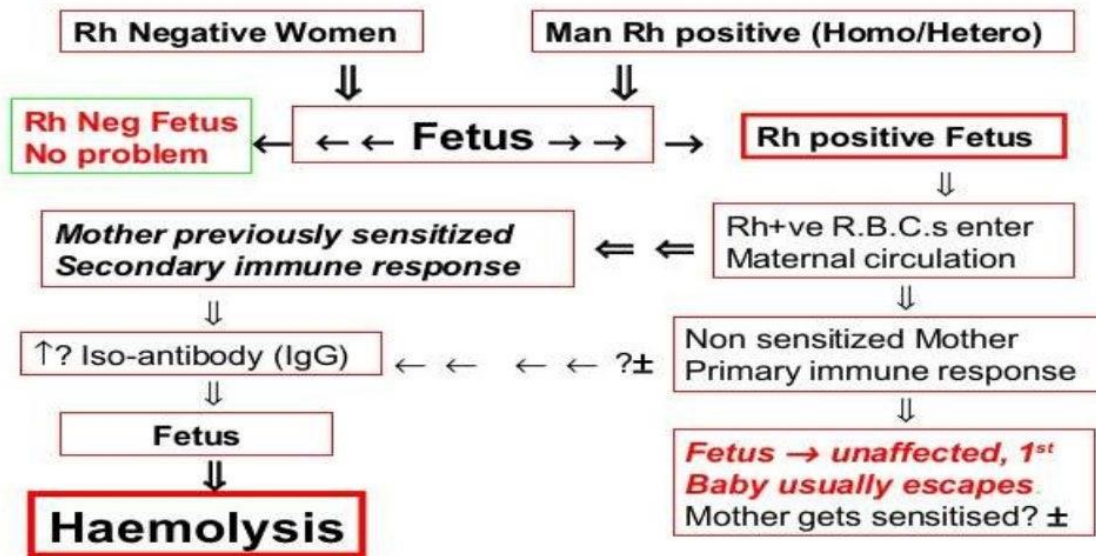
Rh incompatibility occurs when a person whose Rh-negative becomes pregnant with a fetus with Rh-positive blood. With Rh incompatibility, your immune system reacts to this difference (known as incompatibility) and creates antibodies. These antibodies drive an immune system attack against the fetus's red blood cells, which your body thinks are foreign objects. This is called Rh sensitization.

During pregnancy you don't share blood with the fetus you're carrying. However, a small amount of blood from the fetus can mix with your blood during labor and delivery (either vaginal or cesarean). It can also happen during:

- Tests like amniocentesis and chorionic villus sampling (CVS).
- Any type of vaginal bleeding for the duration of pregnancy.
- Injury or trauma to your abdomen.
- Early being pregnant headaches like miscarriage or ectopic pregnancy.

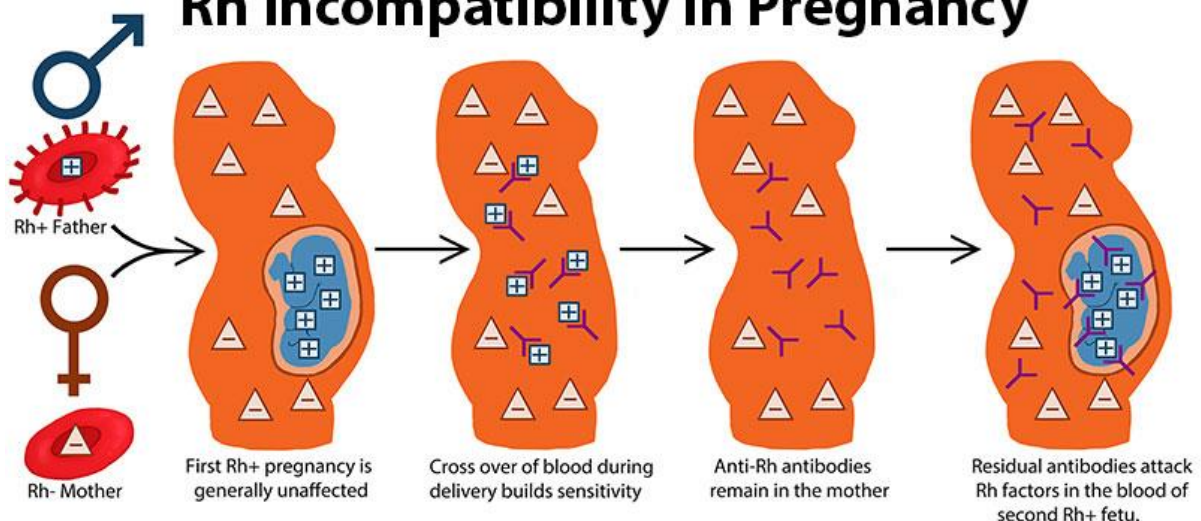
Rh factor of the father	Rh factor of the mother	Rh factor of the child	Risk of Rh incompatibility
Rh positive	Rh positive	Rh positive	No risk
Rh negative	Rh negative	Rh negative	No risk
Rh positive	Rh negative	Chances are there for the fetus to be Rh positive	The newborn is at risk for Rh incompatibility

Pathogenesis Of Rh Iso-immunisation



Maternal immune system becomes sensitized when there is fetal blood leak into the maternal circulation response is forming IgM antibodies for short period followed by production Initial of IgG which crosses placenta. IgG antibodies binding to the antigen sites on erythrocyte surfaces trigger hemolysis. This accelerated removal of circulating red blood cells results in profound anemia and hypoxia.

Rh Incompatibility in Pregnancy



Rh incompatibility occurs when a pregnant woman whose blood type is Rh-negative is exposed to Rh-positive blood from her fetus, leading to the mother's development of Rh antibodies. The inaugural instance of Rh incompatibility was documented in 1939, predating the discovery of the Rh factor, a protein present on the surface of red blood cells. Immunohematologist Philip Levine and doctor Rufus Stetson suggested this pioneering case in *The Journal of the American Medical Association*. Their report depicted an anonymous twenty-five-year-old woman admitted to a local hospital during her thirty-third week of pregnancy due to labor pains and vaginal bleeding. Subsequently, she delivered a severely underweight, stillborn fetus weighing only one pound and five ounces.

The physicians had to expel the woman's placenta to stop her from bleeding to death.

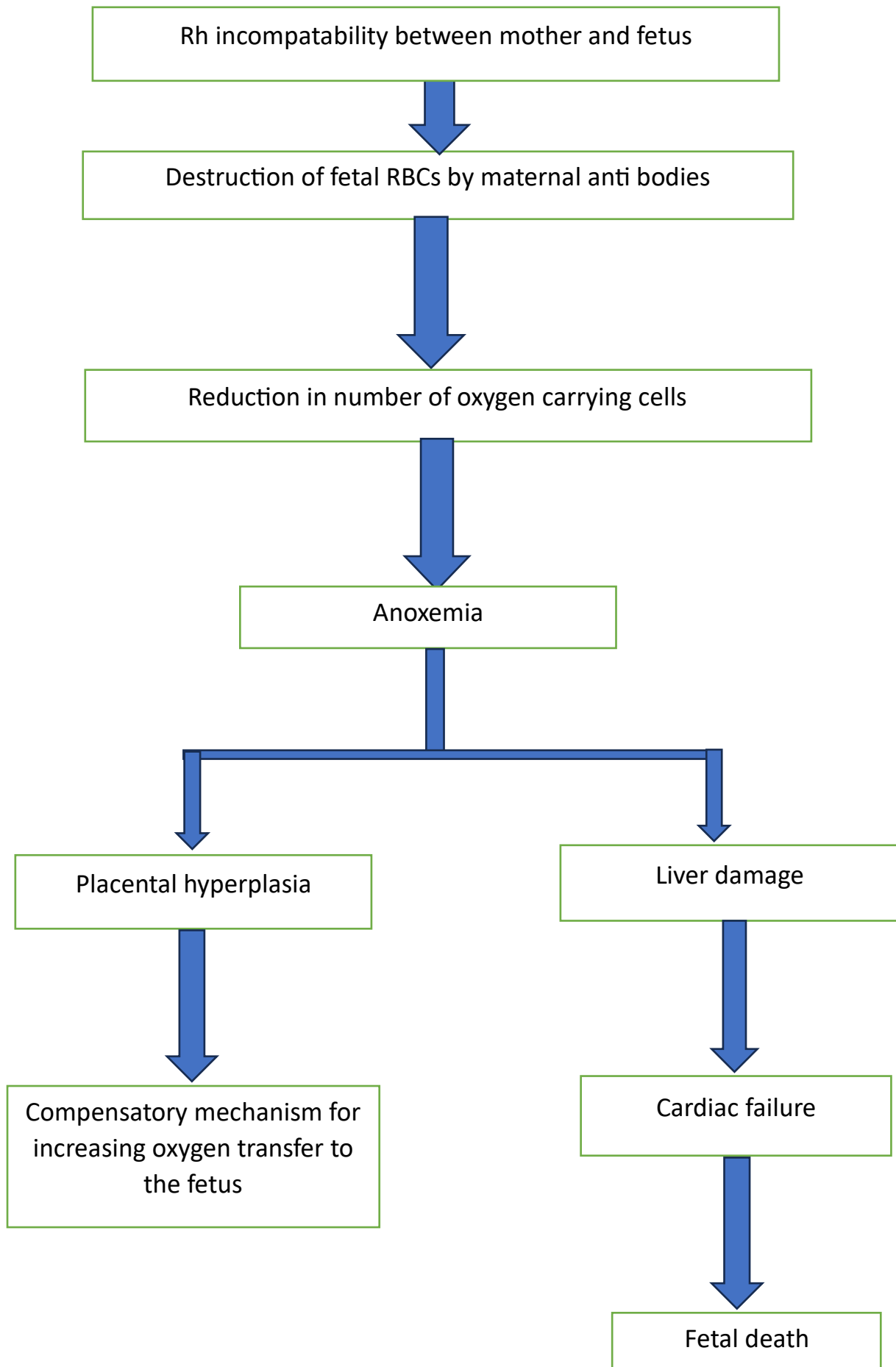
The patient received a blood transfusion from her husband, as the two of them were of blood type O. Shortly after finishing the transfusion, the patient experienced a sudden chill and started to complain of discomfort in her head and legs.

When her vaginal bleeding resumed she was given a hysterectomy, followed by another blood transfusion from a different donor. During her entire hospital stay, the patient received transfusions from a total of 104 type O blood donors.

Remarkably, the mother confirmed no blood transfusion response to twenty-one of these donors. Further tests indicated that the patient's serum or the plasma in the blood minus the clotting factors, specifically agglutinated her donor's cells-or rather, 80 percent of all her blood transfusions.

Sensitizing Events:-

- Spontaneous, complete, or incomplete abortion.
- Elective abortion.
- Trauma.
- Intrauterine fetal death.
- Invasive prenatal procedure(amniocentesis).
- Delivery of Rh+ baby.
- Ectopic pregnancy.



If there is Rh incompatibility between the mother and fetus, leads to the destruction of fetal RBCs by maternal antibodies. Due to this there will be reduction of oxygen carrying cells, which leads to anoxemia. Due to this hyperplasia of placenta takes place which is compensatory mechanism for increasing oxygen transfer to the fetus. Which in turn also leads to liver damage, cardiac failure and finally leads to fetal death.

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