Global Journal of Reproductive Medicine
ISSN: 2575-8594

Juniper Publishers
key to the Researchers

Review Article
Volume 7 Issue 4 - April 2020
DOI: 10.19080/GJORM.2020.07.555720

Glob J Reprod Med

Factors that Determine Fatality of Rhesus Incompatibility

Seriki SA*

Department of Human Physiology, Edo University, Nigeria

Submission: March 15, 2020; **Published:** April 13, 2020

***Corresponding author:** Seriki SA, Department of Human Physiology, College of Medical Sciences, Edo University, Iyamho, Nigeria

Abstract

Erythroblastosisfetalis, otherwise described as Haemolytic Disease of the New-born (HDN)occurs when red blood cells (RBC) of fetus break quickly as a result of passage of immunoglobulin-G (IgG) molecules (an antibody produced by the mother) through the placenta into the fetal circulation causing serious reaction that tends to destroy the red cell of the fetus. The current study reviews the pathophysiology of the disease; specifically, it focuses on the factors that determine maternal response to sensitization and also the factors that determine the fatality of response in an exposure. Indeed, it examinesbetween volume of exposure, maternal immune sensitivity and recurrence of exposure, which determines response and fatality. The study observed that although maternal immune sensitivity determines how fast her body responds to sensitization (and not necessarily the volume), the fatality of response is dependent on volume and recurrence of exposure.

Keywords: Erythroblastosisfetalis; Alloimmune condition; Immunoglobulin-G; Haemolysis; Hydropsfetalis; Reticulocytosis

Introduction

The Rhesus factor was first discovered in a monkey as a red cell surface antigen. Its incompatibility, also known as Rh disease, arises when a woman with Rh-negative blood type is conceived of fetus with Rh-positive blood cells, leading to the development of Rh antibodies [1]. The alloimune condition develops in a fetus, when the immunoglobulin-G (IgG) molecules (one of the five main types of antibodies) produced by the mother crosses through the placenta to the fetus resulting in reaction that tends to destroy the red blood cell of the foetus [2]. Some of these antibodies attack antigens on the red blood cells (RBC) of the fetal circulation and break down the red cells and destroy it completely, a condition described as haemolysis. The consequence is that the fetusdevelopsanaemia and reticulocytosis. The disease may range from mild to very severe, and could even result in death of fetusfrom severe heart failure, a condition known as hydropsfetalis. In severe and moderate condition of the disease, many immature red blood cells (erythroblasts) are present in the fetal blood; hence it is referred to as erythroblastosisfetalis [2,3]. HDFN denies the fetus its immune privilege or some other form of impairment of the immune tolerance of pregnancy. Alloantigen responses are provoked by various types of HDFN classifications. They include ABO, anti-RhD, anti-RhE, anti-Rhc, anti-Rhe, anti-RhC, multiantigen combinations, and anti-Kell [4].

Mortality/Morbidity

The binding of maternal Rh antibodies produced after sensitization with fetal Rh-positive erythrocytes results in fetal autoimmune hemolysis, making the fetus the primary or sole victim of the reaction. Consequently, large amounts of bilirubin are produced from the breakdown of fetal hemoglobin and are transferred via the placenta to the mother where they are subsequently conjugated and excreted by the mother. However, once delivered, low levels of glucuronyltransferase in the infant preclude the conjugation of large amounts of bilirubin and may result in dangerously elevated levels of serum bilirubin and severe jaundice [4]. Bilirubin levels typically peak between 3 to 7 days after birth. Mildly affected infants may have little or no anemia and may exhibit only hyperbilirubinemia secondary to the continuing hemolytic effect of Rh antibodies that have crossed the placenta. Moderately affected infants may have a combination of anemia and hyperbilirubinemia/jaundice. In severe cases of fetal hyperbilirubinemia, kernicterus develops. Kernicterus is a neurologic syndrome caused by deposition of bilirubin into central nervous system tissueswhich can cause permanent brain damage.It usually occurs several days after delivery and is characterized by loss of the Moro (ie, startle) reflex, posturing, poor feeding, inactivity, a bulging fontanelle, a high-pitched shrill

cry, and seizures. Infants who survive kernicterus may go on to develop hypotonia, hearing loss, and mental retardation [4]. The most severe form of erythroblastosisfetalis is hydropsfetalis, which is characterized by high output cardiac failure, edema, ascites, pericardial effusion, and extramedullary hematopoiesis. Newborns with hydropsfetalis are extremely pale with hematocrits usually less than 5. Hydropsfetalis often results in death of the infant shortly before or after delivery and requires an emergent exchange transfusion if there is to be any chance of infant survival [4].

Rhesus Factor and Race

Approximately 15-20% of white patients, as opposed to 5-10% of black patients, have the Rh-negative blood type. Among individuals of Asian and American Indian descent, the incidence of Rh-negative blood type is less than 5% [5].

Complications

Complications of HDN could include kernicterus, hepatosplenomegaly, inspissated (thickened or dried) bile syndrome and/or greenish staining of the teeth, haemolytic anaemia and damage to the liver due to excess bilirubin. Similar conditions include acquired haemolytic anaemia, congenital toxoplasma and syphilis infection, congenital obstruction of the bile duct and cytomegalovirus infection [6,7]. Rh incompatibility can occur by two main mechanisms;when an Rh-negative pregnant mother is exposed to Rh-positive fetal red blood cells secondary to fetal-maternal hemorrhage during the course of pregnancy from spontaneous or induced abortion, trauma, [8] invasive obstetric procedures, or normal delivery. Rh incompatibility can also occur when an Rh-negative female receives an Rh-positive blood transfusion. This is however uncommon where blood screening is done before transfusion. In part, this is the reason that blood banks prefer using blood type "O negative" or "type O, Rh negative," as the universal donor type in emergency situations when there is no time to type and cross-match blood [8]. The three most common models by which a woman becomes sensitized towards a particular antigen are

a) Fetal-maternal haemorrhage occuring due to abortion, childbirth, ruptures in the placenta during pregnancy, or medical procedures carried out during pregnancy that breaches the uterine wall

b) The woman may have received a therapeutic blood transfusion. ABO blood group system and the D antigen of the Rhesus (Rh) blood group system typing are routine prior to transfusion

c) The third sensitization model can occur in women of blood type O.

Maternal Child Rhesus Incompatibility

The most common cause of Rh incompatibility is exposure from an Rh-negative mother by Rh-positive fetal blood during pregnancy or delivery. As a consequence, blood from the fetal circulation may leak into the maternal circulation, and after a significant exposure, sensitization occurs, leading to maternal antibody production against the foreign Rh antigen (the antigen of the foetus).

Once produced, maternal Rh immunoglobulin G (IgG) antibodies persist for life and may cross freely from the placenta to the fetal circulation, where they form antigen-antibody complexes with Rh-positive fetal erythrocytes and eventually destroy them, resulting in a fetal alloimmune-induced hemolytic anemia [9]. Although the Rh blood group systems consist of many antigen subtypes (eg, D, C, c, E, e), the D antigen is the most immunogenic; therefore, it is most commonly involved in Rh incompatibility abnormalities.

Discussion

1.1. Pathophysiology of rhesus incompatibility

The amount of fetal blood necessary to produce Rh incompatibility varies. A previous study has observed that less than 1 mL of Rh-positive blood sensitized volunteers with Rh-negative blood, suggesting that small volume could trigger response. Other studies have suggested that 30% of persons with Rh-negative blood never develop Rh incompatibility, even when sensitized with large volumes of Rh-positive blood [10]. Once sensitized, it takes approximately one month for Rh antibodies in the maternal circulation to equilibrate in the fetal circulation. In large number of cases, sensitization occurs during delivery. Therefore, most firstborn infants with Rh-positive blood type are never really affected because the short period from first exposure of Rh-positive fetal erythrocytes to the birth of the infant is insufficient to produce any significant maternal IgG antibody response. The risk and severity of response to sensitization continue to increase with each subsequent pregnancy involving a fetus with Rh-positive blood. In women who are prone to Rh incompatibility, the second pregnancy with an Rh-positive fetus often produces a mildly anemic infant, whereas succeeding pregnancies produce more seriously affected infants who ultimately may die in utero from massive antibody-induced hemolytic anemia [10]. The incidence of Rh incompatibility in the Rh-negative mother who is also ABO blood grouping incompatible with the fetus is reduced dramatically to 1-2% and is believed to occur because the mother's serum contains antibodies against the ABO blood group of the fetus. The few fetal red blood cells that are mixed with the maternal circulation are easily and quickly destroyed before Rh sensitization can proceed to a significant extent [11]. Risk of sensitization depends largely upon the following 3 factors: Volume of trans-placental hemorrhage, extent of the maternal immune response, recurrence of incidence of Rh-positive pregnancy, and concurrent presence of ABO incompatibility. The four factors contribute in one way or the other to the fatality of Rh incompatibility. The extent of contribution may vary in individual patient depending on extent

How to cite this article: Seriki S. Factors that Determine Fatality of Rhesus Incompatibility. Glob J Reprod Med. 2020; 7(4): 5556720.
DOI: 10.19080/GJORM.2020.07.555720

of recurrence, and maternal sensitivity. None of the factors can be overlooked by clinicians when managing Rh incompatibility cases, as this may contribute to management outcome in patients. It must alsobe added that Rh incompatibility is only of medical concern for females who are pregnant or plan to have children in the future. Rh-positive antibodies circulating in the bloodstream of an Rh-negative woman otherwise have no adverse effects whatsoever.

Conclusion

Volume of trans-placental hemorrhage, extent of the maternal immune response, recurrence of incidence of Rh positive pregnancy, and concurrent presence of ABO incompatibility are all contributing factors to severity of Rh factor disease, and should therefore be given attention.

References

1. Guyton AC, Hall JE (2006) Textbook of Medical Physiology. (11th edn.), Elsevier Saunders, Amsterdam, USA.
2. Hatfield NT (2007) Broadribb's Introductory Pediatric Nursing. Lippincott Williams & Wilkins, USA, pp. 251.
3. Bowman JM (1989) Hemolytic disease (erythroblastosis fetalis) Maternal-Fetal Medicine: Principles and Practice, (2nd edn.), Philadelphia, Pa: WB Saunders, USA, pp. 613-655.
4. Torsten J Schulze, Meike Goebel, Erwin A Scharberg, Peter Bugert, Karin Janetzko (2013) Development of Anti-G, Anti-C and Anti-Jk(b) in a 22-Year-Old Mother during Her Fourth Pregnancy. Transfus Med Hemother 40(3): 207-209.
5. (2004) US Preventive Services Task Force. Screening for Rh(D) incompatibility: recommendation statement. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ).
6. Sameer W, Muhammad A (2017) Hemolytic Disease of the Newborn Treatment & Management. Drugs & Diseases Pediatrics. Cardiac Disease and Critical Care Medicine.
7. Peterec SM (1995) Management of neonatal Rh disease. ClinPerinatol 22(3): 561-592.
8. Thorp JM (2008) Utilization of anti-RhD in the emergency department after blunt trauma. Obstet Gynecol Surv 63(2): 112-115.
9. Elalfy MS, Elbarbary NS, Abaza HW (2011) Early intravenous immunoglobin (two-dose regimen) in the management of severe Rh hemolytic disease of newborn--a prospective randomized controlled trial. Eur J Pediatr 170(4): 461-467.
10. Nathalie A (2011) Rh Incompatibility in Pregnancy. The Embryo Project Encyclopedia.
11. Mourant AE, Kopec AC, Domaniewska Sobczak K (1976) The Distribution of the Human Blood Groups and Other Biochemical Polymorphisms. (2nd Edn.), England: Oxford University Press, London.

DOI: 10.19080/GJORM.2019.07.5556720

How to cite this article: Seriki S. Factors that Determine Fatality of Rhesus Incompatibility. Glob J Reprod Med. 2020; 7(4): 5556720. DOI: 10.19080/GJORM.2020.07.555720