Original Article

ABO and Rh Blood Group Incompatibility among Icteric Neonates and their Mothers in Jos, Nigeria

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Abstract

Context: ABO and Rh blood groups play significant roles in health and diseases, one of which is blood group incompatibility, a common cause of neonatal hyperbilirubinemia. **Aims:** The aim of the study is to determine the frequency of ABO and Rh blood group incompatibilities among icteric neonates and their mothers for the purpose of instituting intervention for better neonatal outcomes. **Settings and Design:** This study was conducted at the Special Care Baby Units (SCBUs) of the Jos University Teaching Hospital (JUTH), Bingham University Teaching Hospital (BHUTH), and Plateau State Specialist Hospital (PSSH), Jos, Nigeria, from March 2013 to February 2014. It was a descriptive cross-sectional study that includes all jaundiced neonates admitted into the SCBUs and neonates who developed jaundice on admission in the neonatal wards. **Subjects and Methods:** A total of 150 icteric neonates admitted into the SCBUs of the JUTH, PSSH, and the BHUTH were recruited for this study with their parent's consent. Blood samples were collected from the neonates and their mothers in ethylene diaminetetra-acetic acid and plain bottles for ABO and Rh blood grouping, direct antihuman globulin test, and serum bilirubin (SB) assays. **Statistical Analysis Used:** Data obtained were analyzed using Epi Info Version 6 software. The results were reported in tables and frequencies, categorical variables were expressed as proportions, whereas continuous variables were expressed as mean ± standard deviation and were analyzed using Student's "*t*"-test. The level of statistically significant relationship was set at $P \leq 5\%$ ($P \leq 0.05$). **Results:** Thirty-four (22.7%) mother–neonate pair had ABO incompatibility with 14 mothers (9.3%) with blood group O, having neonates with blood group A and a mean SB of 249.5 ± 131.4 μmol/L. Three (2.0%) mothers were Rh D negative while their neonates were Rh D positive and showed a positive direct antihuman globulin test with a mean SB of 322.1 ± 246.7 μmol/L. **Conclusions:** Blood group O and Rh D-positive blood groups predominate while ABO and Rh incompatibilities present a risk for hyperbilirubinemia among icteric neonates in Jos, Nigeria.

Keywords: Blood group, hyperbilirubinemia, incompatibility, neonate

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Introduction

Blood groups are based on the existence of antigens made up of molecules such as glycoproteins and glycolipids on the red blood cell membranes.[1] Approximately 400 blood group antigens have been described, with the ABO and Rh blood groups being the most frequently studied genetic markers in humans.[2,3] The ABO blood group determined by the presence or absence of blood group antigens A or B has a natural distribution among humans with the O blood group predominating in most instances, followed by blood group A.[4-6]

The Rh blood group system is the second most frequent blood group system of clinical significance determined by a highly immunogenic Rh D antigen.[6] Human populations with Rh-negative status are few with slight racial differences, 5.5% in South India, 5% in Nairobi, and 4.8% in Nigeria, while the Caucasians have a 15% rate of Rh-negative blood group.[7-9]

In blood group immunology, individuals who lack a particular blood group antigen produce antibodies against that antigen leading to an immunologic reaction, hemolysis, and

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hyperbilirubinemia, as it can occur in pregnancy because of fetomaternal transfusion.[9] ABO incompatibility occurs most frequently but rarely causes severe haemolytic disease of the foetus and newborn (HDFN), while the highly immunogenic Rh D antigen can cause immune response with severe HDFN.[9-11]

Studies among Nigerian children have shown that neonatal jaundice is a significant cause of morbidity and mortality in the pediatric age group.[12-17] This study is to determine the frequency of ABO and Rh blood group incompatibility among icteric neonates and their mothers with a view on raising awareness on the knowledge of blood groups, screening, and prophylaxis against isoimmunization in pregnancy, thereby improving the outcome of hemolytic disease of the fetus and newborn with its attendant complications.

Subjects and Methods

This study was conducted at the Special Care Baby Units (SCBUs) of the Jos University Teaching Hospital, Bingham University Teaching Hospital, and Plateau State Specialist Hospital, Jos, Nigeria, from March 2013 to February 2014. It was a descriptive cross-sectional study that includes all jaundiced neonates admitted into the SCBUs and neonates who developed jaundice on admission in the neonatal wards. Neonates whose parents did not consent, those with cephalhematomas, bleeding tendencies, birth asphyxia, and those recently transfused were excluded from the study. Ethical approval was obtained from the Ethics Committee of the participating institutions, while written informed consent was obtained from the parents or guardians of the neonates. The neonates were recruited using the nonprobability convenience sampling technique, and the questionnaire was self-administered to obtain relevant information. The neonates were examined, and 5 ml of the blood sample was collected for ABO and Rh blood group, direct antihuman globulin test, and serum bilirubin (SB) assays. Three milliliters of mothers' blood sample was also collected for ABO and Rh blood grouping. SB concentration >104 μmol/L was considered pathologic. Data obtained were analyzed using Epi Info Version 6 software (CDC 2000, Atlanta, Georgia, USA). The results were reported in tables and frequencies, categorical variables were expressed as proportions, whereas continuous variables were expressed as mean ± standard deviation and were analyzed using Student's "*t*"-test. The level of statistically significant relationship was set at $P \leq 5\%$ ($P \leq 0.05$).

Results

Sixty-three (42.0%) of 150 neonates and 85 (56.7%) of 150 mothers were ABO blood group O. One hundred and forty-six (97.3%) neonates were Rh D positive, while 4 (2.7%) mothers were Rh D negative [Table 1].

Mother–neonates ABO and Rh blood group incompatibility

Thirty-four (22.7%) mother-neonate pairs were ABO incompatible. Twenty (13.3%) blood group O mothers had 20 (13.3%) neonates with blood group B and a mean SB of 249.5 ± 131.4, while 14 (9.3%) mothers had neonates with blood group A and a mean SB of 229.5 ± 110.0 μmol/L. Two (1.3%) of those with ABO incompatibility had a positive direct antihuman globulin test. Three (2.0%) mother–neonate pairs were Rh D negative-positive with positive direct antihuman globulin test and SB of 322.1 ± 246.7 μmol/L, whereas three others pairs were Rh D positive–negative and with negative direct antihuman globulin test. No statistically significant difference was found in the severity of hyperbilirubinemia between the groups with ABO or Rh incompatibility, *P* values of 0.63 and 0.99, respectively [Table 2].

Discussion

This study demonstrated the predominance of blood group O and Rh positivity in both the neonates and their mothers. These findings are in accordance with other studies in Nigeria as documented by Bakare *et al*. in Ogbomosho, South West, Nigeria, and Pennap *et al*. in Keffi, North Central Nigeria.[18,19] Racial differences may exist in the distribution of some of the ABO blood group antigens, but no significant differences were found comparing the prevalence of 45.2%, 39.7%, 10.9%, and 4.1% for blood groups O, A, B, and AB among the Caucasians in the United States with the frequencies for the neonates and their mothers in our study.[20] ABO incompatibility is the most commonly reported serologic cause of neonatal jaundice but clinically mild as a cause of hemolytic disease of the newborn (HDFN) with hyperbilirubinemia than the Rh incompatibility.[20,21] This could be attributed to the fact that Rh incompatibility which was once an extremely common cause of severe hemolysis has now been reduced by the prophylactic

Table 1: Mothers' and neonates' blood groups

Blood group	Mother (*n*=150), *n* (%)	Baby (*n*=150), *n* (%)
ABO		
O	85 (56.7)	63 (42.0)
A	24 (16.0)	34 (22.7)
B	33 (22.0)	47 (31.3)
AB	8 (5.3)	6 (4.0)
Total	150 (100)	150 (100)
Rh		
Positive	146 (97.3)	146 (97.3)
Negative	4 (2.7)	4 (2.7)
Total	150 (100)	150 (100)

Table 2: Mother-neonates ABO and Rh blood group incompatibility

Blood group	Mother-neonate incompatibility	*n*	DAT		SB (μmol/L)	*P*
			Positive	Negative		
ABO	O-A	14	0	14	249.5±131.4	0.63
	O-B	20	2	18	229.5±110.0	
Total		34	2	32		
Rh	Positive-negative	3	0	3	324.2±198.8	0.99
	Negative-positive	3	3	0	322.1±246.7	
Total		6	3	3		

DAT: Direct antihuman globulin test, SB: Serum bilirubin

administration of anti-D globulin to Rh-negative mothers.[21] Frequency of ABO incompatibilities in our study was higher than Rh incompatibility, but the direct antihuman globulin test did not confirm the isoimmunization in most of them, except for Rh-negative mothers with Rh-positive neonates where the evidence of isoimmunization was demonstrated in all. The low antigenicity expressed at birth, naturally occurring in anti-A and anti-B which are predominantly immunoglobulin (Ig) M, and anecdotal reports suggesting that direct antihuman globulin test has low sensitivity may be responsible for the inability to confirm isoimmunization in the neonates at risk of blood group incompatibilities in this study.[22] Hyperbilirubinemia of varying degrees was demonstrated where these incompatibilities were found; however, no statistical difference was noticed among those with ABO or Rh incompatibilities. This finding does not support variation in immunogenicity, especially between anti-A and anti-B, where HDFN in blacks due to anti-B is said to be more severe than with anti-A.[23] Other risk factors for neonatal hyperbilirubinemia were not considered in this studies such as neonatal sepsis and enzymopathies could coexist with the blood group incompatibility; however, Kaplan *et al*. reported no difference in the degree of hyperbilirubinemia even in the presence of these risk factors.[24]

Frequency of ABO incompatibility, 22.7% in this study is in contrast to 7.6% reported by Israel-Aina and Omoigberale in Benin.[25] This marked difference may not be unconnected to the size of our study population. On direct antihuman globulin test, our finding was close to the rate of 5% reported by Fadairo *et al*. in Ile-Ife, but in contrast to a previous report that about 36% of Nigerian babies with ABO incompatibility may have evidence of isoimmunization.[26,27] Contrary to the frequency found in our study, Manning *et al*. study in the United Kingdom and several other researchers in Canada and Turkey, reported ABO incompatibility as the most common cause of neonatal jaundice followed by Rh incompatibility and G6PD deficiency.[28-30] This report may be as a result of the few Rh-negative individuals as well as the low prevalence of G6PD deficiency in their environment.[28-30]

Introduction of anti-D and increase awareness has reduced the spectrum of HDFN over the past few decades in Europe and America shifting attention to other allo-antibodies which could be the cause of the emerging HDFN being encountered in developed societies. The low prevalence of Rh incompatibility observed in this study is not surprising due to increase awareness and antenatal clinic attendance as well as the few Rh-negative women in the African and Asian populations.[31,32] However, isoimmunization was confirmed in all the Rh-positive neonates, whose mothers were negative and this call for early monitoring and administration of anti-D to Rh-negative mothers for better neonatal outcomes.

Neonatal sepsis, G6PD deficiency, and other causes of neonatal jaundice may be responsible for the hyperbilirubinemia seen in the other neonatal population not accounted for in this study. Collaboration for further studies that will include detailed red blood cell-specific antigen and antibody screening, G6PD enzyme assay, as well as microbiological search for pathogens that could cause neonatal hyperbilirubinemia in our environment will be pursued in due course.

Conclusions

ABO and Rh blood group distribution in this study closely reflect the global distribution of blood groups, while ABO incompatibility has been shown to be a relatively common occurrence among mothers and neonates in our environment compared to Rh incompatibility. In view of the neonatal morbidity and mortality associated with hyperbilirubinemia, every possible cause of hyperbilirubinemia including all blood group incompatibilities in our environment must be investigated using the quality standard screening test during pregnancy for early diagnosis and institution of prophylactic measures for better neonatal care.

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Conflicts of interest

There are no conflicts of interest.

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