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Prevalence of alloantibodies associated with haemolytic disease of the fetus and newborn in pregnant women at the Ekiti State University Teaching Hospital, Ado-Ekiti, Southwest Nigeria

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Abstract

Haemolytic disease of the fetus and newborn (HDFN) is caused by maternal alloimmunization against red blood cell antigens, which could result in fetal anaemia, hyperbilirubinaemia, kernicterus, and death. This study was designed to determine the prevalence of alloantibodies against erythrocyte antigens in blood samples of pregnant women during the first trimester which may cause HDFN. A total of 123 consenting pregnant women attending the antenatal clinic of Ekiti state University Teaching Hospital, Ado Ekiti participated in the study which lasted three months. The participants were within the ages of 16 to 45 years old across the major ethnic group in Nigeria. ABO/Rh typing, screening and identification of red blood cell alloantibodies were carried out using standard protocols. 15 (12.2%) subjects had detectable antibodies known to cause haemolytic disease of the fetus and newborn (HDFN). The specificity of the antibodies was as follows: anti-K (5, 33%), anti-k (3, 20%), anti- Jsa (2, 13%), anti-C. (3, 20%), and anti-E (2, 13 %). Based on ethnicity, the prevalence of Kell antibodies was highly significant among the Yorubas as well as anti-C and anti-E. The observation was similar in the Igbo and Hausa groups. There is a need to determine these antibodies and monitor their titre in pregnant women to manage or prevent the morbidity and mortality associated with HDFN during routine antenatal care. *(Afr J Reprod Health 2023; 27[6s]: 70-78).*

Keywords: Alloimmunization, alloantibodies, hemolytic disease of the newborn, incompatible blood transfusion

Résumé

La maladie hémolytique du fœtus et du nouveau-né (HDFN) est causée par l'allo-immunisation maternelle contre les antigènes des globules rouges, ce qui peut entraîner une anémie fœtale, une hyperbilirubinémie, un ictère nucléaire et la mort. Cette étude a été conçue pour déterminer la prévalence des allo-anticorps contre les antigènes érythrocytaires dans les échantillons de sang des femmes enceintes au cours du premier trimestre qui peuvent causer HDFN. Un total de 123 femmes enceintes consentantes fréquentant la clinique prénatale de l'hôpital universitaire d'État d'Ekiti, Ado Ekiti, ont participé à l'étude qui a duré trois mois. Les participants étaient âgés de 16 à 45 ans dans le principal groupe ethnique du Nigeria. Le typage ABO/Rh, le dépistage et l'identification des allo-anticorps érythrocytaires ont été réalisés selon des protocoles standards. 15 (12,2 %) sujets avaient des anticorps détectables connus pour provoquer une maladie hémolytique du fœtus et du nouveau-né (HDFN). La spécificité des anticorps était la suivante: anti-K (5, 33%), anti-k (3, 20%), anti-Jsa (2, 13%), anti-C. (3, 20 %) et anti-E (2, 13 %). Sur la base de l'ethnicité, la prévalence des anticorps de Kell était hautement significative parmi les Yorubas ainsi que les anti-C et anti-E. L'observation était similaire dans les groupes Igbo et Hausa. Il est nécessaire de déterminer ces anticorps et de surveiller leur titre chez les femmes enceintes pour gérer ou prévenir la morbidité et la mortalité associées à HDFN lors des soins prénatals de routine. *(Afr J Reprod Health 2023; 27[6s]: 70-78).*

Mots-clés: Alloimmunisation, alloanticorps, maladie hémolytique du nouveau-né, transfusion sanguine incompatible

Introduction

Incompatibility between maternal and fetal red blood cells may cause Haemolytic disease of the fetus and the newborn (HDFN), a clinical condition resulting in haemolysis/ destruction of fetal or neonatal red blood cells (RBCs) due to transfer of maternal IgG antibodies that can cross the placenta. HDFN is characterized by neonatal anemia, hyperbilirubinemia and sometimes even fatal

hydrops fetalis[1]. Over 98% cases of HDFN are caused due to antibodies against Kell, c, E, C, Kidd, Duffy antigens or ABO and Rh incompatibility[2]. These antibodies have also been implicated in the most severe blood transfusion reactions and as such their investigations are clinically significant[3]. Antibody detection and identification are fundamental to the practice of immunohaematology, as they provide a guide on the clinical significance of the antibody which can help in the selection of suitable blood for the purpose of transfusion. Prenatal immunohaematological care of pregnant women requires the investigation of unexpected RBCs antibodies in their sera during pregnancy[4].

Karamatic *et al*, in 2022 reported the molecular bases of five Er blood group antigens: they recognised Era, Erb and Er3 antigens; and two novel high frequency Er antigens, it was described as Er4 and Er5, establishing a new and 44th blood group system[5].

More than 50 red blood cell (RBC) alloantibodies have been estimated to be the major cause of transfusion reactions in pregnancy or haemolytic disease of the fetus and newborn (HDFN) especially the Rh antibodies[6]. Anti-Er4 and anti-Er5 are involved in severe hemolytic disease of the fetus and newborn[5] (HDFN).

The exposure to D – antigen is clinically significant if the maternal anti-D is IgG (sensitization), the IgG can cross the placenta causing severe complications such as haemolytic disease of fetus and the newborn (HDFN)[5,7]. Haemolytic disease of fetus and the newborn (HDFN) can occur in three ways depending on the red cell antigen causing the maternal immunization. These are 1). HDFN due to ABO antigens (ABO incompatibility), 2). HDFN due to Rh either due to anti-D alone or other Rh antibodies such as anti-C, anti-c, anti-E, or anti-e., and 3). HDFN caused by non –Rh -D immune antibodies such as anti K, jk, Fy, Er4 and Er5. HDFN caused by Rh, Er4 and Er5 remains the most common and severe type[5,7]. Maternal alloimmunization against red cell antigens usually develop following first pregnancy, blood transfusions and transplantation can be a prerequisite for the development of HDFN[8]. Though, the introduction of immune globulin (RhiG) prophylaxis has significantly reduced the incidence of pregnancies complicated by anti-D, the need to detect and monitor anti- D and other allo-antibodies that could cause HDFN and transfusion reactions is still remains a vital concern[9]. Alloantibodies to red blood cell (RBC) antigens of the fetus other than Rh (D) can cause blood transfusion reactions or clinically significant haemolysis of fetal and newborn RBCs[9]. These red cell alloantibodies found in sera of pregnant women have been studied in many parts of the world and have been discovered to be more frequent in most developing countries[10]. Haemolytic disease of fetus and the newborn (HDFN) has for a long time being a major cause of prenatal morbidity and mortality[11]. Though, it has been discovered that 98% of neonatal deaths occurs in developing countries, neonatal mortality rate is the highest in the sub-Saharan regions of western, middle, and eastern Africa and South-Central Asia[12]. The current ***infant mortality rate*** for Nigeria ***in 2023*** is estimated to be 54.740 deaths per 1000 live births, a 2.63% decline ***from*** 2022. The current birth rate for World in 2023 is 17.464 births per 1000 people, a 1.15% decline from 2022[13]. Therefore, the broad objective of the study is to determine the occurrence of red cell antibodies in pregnant women attending Federal Teaching Hospital, Ido-Ekiti. The Specific objectives are to detect the presence of red cell antibodies in the sera of pregnant women at the first trimester of pregnancy and to identify the types of erythrocyte antibodies in the sera of pregnant women at the first trimester of pregnancy. The research questions were are there detectable alloantibodies in the sera of pregnant women in the first trimester of pregnancy? What is the occurrence of the various types of alloantibodies in the first trimester of pregnancy.

Methods

Study design

A cross-sectional design was used in this study. Samples were collected randomly, after obtaining a written or oral informed consent from the participants. Institutional approval was received from the Department of Medical Laboratory Services of the Ekiti State University Teaching Hospital, Ado Ekiti.

Study population

A total number of One hundred and twenty-three (123) pregnant women attending antenatal clinic of Ekiti state University Teaching Hospital, Ado Ekiti were recruited into this study, for the period of three months (April through June, 2017). The participants were within the age of 16 to 45 years old of age. Their obstetric and transfusion histories were obtained through structured questionnaires, which accompanied antenatal requests.

Collection and processing of samples

Five milliliters of whole blood were drawn with syringe (5 mL) through venepuncture using the antecubital vein. Two millilitre of whole blood was dispensed into a well labeled EDTA bottle and was used for ABO and Rh grouping using standard protocol. The other three millimeter of blood was allowed to clot in a plain bottle, centrifuged at 300 rpm for 5 min, and the serum separated into a separate a well labeled plain tube with a cap.

Determination of ABO and Rh Blood Groups

ABO blood grouping was done using anti-A, anti-B, and anti-AB bought from Biotec (Ipswich, UK) with standard tube agglutination technique. All blood group tests were confirmed with known test RBCs. Controls were included in all tests. ABO blood group tests were done only at room temperature. Reverse grouping cells were supplied by the same company, Biotec.

Rh grouping was done using anti-D monoclonal reagent bought from Biotec. Rh controls were provided in all tests[16]. Tests were done in tubes and all negative results were confirmed using indirect agglutination test technique with 20% bovine albumin and anti-human globulin (AHG) tests at 37°C. After spinning for 20 seconds at 300 rpm, the RBC was gently resuspended and then observed macroscopically and confirmed microscopically before recording the result as positive or negative.

Antibody screening and identification

DiaMed (Switzerland) kit with antibody screening panel (3 cells) and identification panel (11 cells) was used to screen and identify alloantibodies by tube method in low ionic strength solution, albumin, and Anti Human Globulin phase, the assay was carried out according to the manufacturer's instructions[3].

Data analysis

The study employed a descriptive approach using frequency distribution and proportions to estimate the prevalence of alloantibodies associated with hemolytic disease of the fetus and newborn in pregnant women. The specificity of the antibodies was also estimated to account for various antibody prevalences.

Ethical consideration

Ethical approval was obtained in accordance with the Helsinki declaration from the Health Research Ethical Committee, Afe Babalola University, Ado Ekiti (Protocol No: ABUADREC/10/05/2017/17). The study participants were informed about the purpose of the study and written consent was obtained from each participant before sample collection.

Result

A total of 123 participants were recruited into the study. As shown in Table 1, majority (63%) were aged 26-35 years, all of whom were in their first trimester of pregnancy. Eight (6.5%) participants had a history of previous blood transfusion; none had prior medical history of being administered with immune suppressive drugs, while 62 (50%) had at least three children. The distribution of ethnic groups of gestational mothers in Western part of Nigeria were majorly Yorubas as their population made up 67% of the study population followed by Igbo mothers (13%) and Hausa (13%) mothers as shown in table 1.

As shown in Table 2, 12 (10%) participants had pregnancy complications. The ABO and Rh distribution of the participants as shown in Table 3 which indicate that blood group O was the most common, representing 37% of the sample of pregnant women, followed by blood group B (34.1 %), blood group A (27.6%), blood group AB (1.62 %). The proportion of Rh negative was 15.4%,

Table 1: The frequency distribution of the sociodemographic characteristics of the pregnant women

Variables	Frequency	Percentage (%)
Age		
16-25	29	23.0
26-35	78	63.0
36-45	16	13.0
45-50	0	0.0
>50		0.0
Marital status		
Single	16	14
Married	107	86
Ethnic groups		
Yoruba	82	67.0
Igbo	16	13.0
Hausa	16	13.0
Others	9	7.0
Level of Education		
Secondary	57	47.0
Tertiary	37	30.0
Postgraduate	29	23.0

while Rh positive was 84.6 %. Among the blood groups studied blood group "O" Rh positive was found to have the same positivity rate (4%) as blood group "A" Rh Pos (4%) (Table 3).

Of the 123 subjects examined, 15 (12.2%) had positive antibodies. The specificity of the antibodies were as follows: anti-K (5) 33%, anti-k (3)20%, anti- Jsa (2) 13%, anti-C (3) 20% and 13% anti-E (2) 13 %. (See Table 4). Antibody detection showed that anti – K was more prevalence followed by Rh D antibodies. Samples which tested positive for antibodies were more common among pregnant women with prior histories of childbirth and blood transfusion as observed in Table 5.

90% of total number of subjects worked on were multigravida, while primigravidae made up 10% of the population (Table 1 & 5). Among the total primigravidae and multigravidae Kell antibodies were prevalent in the multigravidae (5%) compared to the primigravidae (2%) whereas anti C and anti –E had a high prevalence in pregnant women with past history of blood transfusion histories (Table 5).

The distribution of the phenotype of those antibodies detected among pregnant subjects was analysed based on ethnicity. The prevalence of kell antibodies was highly prevalent among the Yorubas as well as anti-C and anti-E (Table 5). A total of 12(10%) of the sample had histories of pregnancy complications were positive for anti – k (Table 1 & 5).

Discussion

In this study, the frequency of irregular antibodies in maternal serum was 12.2%. This is high in comparison with values obtained from developed countries, such as Sweden (0.5%), Netherlands (2.7%)[3], By contrast, the results are similar with values obtained from other developing countries such as Mexico where high frequency values of 10.2% has been reported[6,11]. Irregular antibodies in maternal serum were also high, and were similar to those observed by Jeremiah and his colleagues in 2012 to be 3.4%[4].

Primary prevention by using K-, Rhc-, RhE-, and RhC- compatible red blood cell transfusion for women younger than 45 years may prevent up to 40% of cases of haemolytic disease of the newborn[14].

Table 2: The frequency distribution of the medical history of the pregnant women

Variables	Frequency	Percentage (%)
Blood transfusion		
No	115	93.5
Yes	08	6.5
History of previous childbirth		
1 child	12	10
2 children	28	23.0
3 children	21	17
>3 children	62	50
Pregnancy Complication		
Yes	12	10
No	111	90
Medications To Supress Immune Response		
Yes	**0**	**0**
No	**123**	**100**

Among the ABO blood groups studied, blood group O (37%) was found to be more frequent than blood group B (34.1 %), blood group A (27.6%), and blood group AB (1.62 %) respectively and the prevalence of Rh positive among the pregnant women was 84.6 %. This is consistent with the results of studies from Madagascar and Guinea that reported similar trends O>B>A>AB)[15,16]. This is

Table 3: ABO and Rh distribution of pregnant women in relation to outcome of antibody screening

BLOOD GROUP	Positive (%)	Negative (%)	Total Number
ORh Neg	2	7	9
O Rh Pos	4	32	36
A Rh Neg	3	4	7
A Rh Pos	4	23	27
AB Pos	0	2	2
B Neg	0	3	3
B Pos	2	37	39
Total	15	108	123
RH – VE % Total			15.4%
RH +VE %			84.6%

also like the work done by Chima[17]. ABO blood group frequencies among Nigerians have been reported as ranging from blood group O to AB as O> (57.2%), B> (20.7%), A> (20.5%) and AB (1.6%) while the actual prevalence of Rh+ was 94.8% and Rh- was 5.2% of the total population[17]. Frequencies of ABO blood group phenotypes are, however, not uniform across the six geopolitical zones of Nigeria. Although the most common type in all the zones is O and the least common is AB, there are regional and perhaps ethnic differences in the frequencies of A and B[18]. In a systematic review of various works from the six geopolitical zones of the country[19], Anifoweshe, reported a pooled pattern of O > A > B > AB. However, despite these variations, type O is the most common group in Africa[18]. Eight (6.5%) of the total population of gestational mothers had histories of blood transfusion. 100% of subjects never had prior medical history of being administered with immune suppressive drugs while 50% had histories of childbirth with a maximum number of three times. Most of the pregnant women in this study were multiparous. Multiparous women may form alloantibodies to leukocyte, red cells or platelet antigens as a result of an overt or unapparent feto-maternal haemorrhage[20]. Women who form leukocyte antibodies following pregnancy are more likely to have febrile non haemolytic transfusion reactions if subsequently transfused with leukocyte containing blood components[21].

Among the 123 pregnant women studied, 15 (12.2%) of the pregnant women had positive antibodies. Majority of samples which tested positive for antibody screen were majorly from pregnant women with prior childbirth and blood transfusion histories. 75% of women with previous history of blood transfusion had positive antibody screening. Women who have previous history of transfusion are more susceptible to react to blood transfusion unlike those that had no previous history of blood transfusion[22].

Fifteen (12.2%) subjects had positive antibody screening in this study. The specificity of the antibodies were as follows: anti-K (5) 33%, anti-k (3) 20%, anti- Jsa (2) 13%, anti-C (3) 20% and anti-E (2) 13%. Prevalence of non- RhD antibodies in gestational mothers is 0.2–0.3%[24]. Alloimmunization to antigens other than D- antigen in Rh and antigens of other blood group system can lead to hemolytic disease of the fetus and newborn (HDFN) and cause blood transfusion reaction though not only in D- phenotype but also in D+. Anti K frequency was seen in this study as the highest number 5 (33%) of pregnant women with positive antibody screen which is in accordance with a Nigerian study that showed that between 80% and 88% of pregnant women with anti-K antibodies and 40–50% of pregnant women with anti-C antibodies have history of red blood cell transfusion[11]. The frequency of K antigen in this locality is not yet known since there are few studies about Kell frequencies in Nigeria but it is known that after the D antigen, the K antigen is the most immunogenic. Among their cohort studies of pregnant women in Sokoto, North-Western Nigeria, Erhabor and Colleagues obtained a Kell antigen prevalence of 2%[26]. In 2009, Ugboma and Nwauche evaluated the prevalence of Kell antigen among their participants and found that 2% of them had it[27]. HDFN caused by anti-K can be severe[28]. There is evidence that anti-K can recognize K antigens expressed in the early stage of erythroid development in the fetal liver and can cause anemia by suppressing erythropoiesis[29]. HDN mediated by non-RhD antibodies are mostly caused by anti-K and anti-c antibodies[29].

The second highest was anti-k (3) 20%, which is line with the work done on blood donors by Yusuf and colleagues in 2018 with the frequency of 21.7% but the frequency was lower when compared with work done in 2021 among donors in Makkar city, Saudi Arabia with a frequency of 96

Table 4: Prevalence of Rh, MNSs, P, Lewis, Kell, Kidd and Duffy positive antibody screening among the pregnant women

BLOOD GROUP SYSTEM	**RH**					**MNSs**				**P**	**Lewis**		**Kell**				**Kidd**		**Duffy**	
Antibody	D	C	E	c	e	M	N	S	s	P1	Lea	Leb	K	k	Kpa	Jsa	Jka	Jkb	Fya	Fyb
No of positive	0	3	2	0	0	0	0	0	0	0	0	0	5	3	3	2	0	0	0	0

Table 5: Distribution of antibodies in relation to sociodemographic characteristics of the pregnant women

PARITY	No tested	anti-C +ve	Anti C –ve	Anti E +ve	Anti E –ve	Anti K +ve	Anti K -ve	Anti k +ve	Anti k –ve	Anti Jsa +ve	Anti Jsa–ve
Primigravidae	3	2	1	2	1	2	1	2	1	2	1
Multigravida	27	1	26	0	27	3	24	1	26	0	27
ETHNIC GROUP	No tested	anti-C +ve	Anti C –ve	Anti E +ve	Anti E –ve	Anti K +ve	Anti K –ve	Anti k +ve	Anti k –ve	Anti Jsa +ve	Anti Jsa–ve
Yoruba	20	3	17	1	19	3	17	1	19	2	18
Hausa	4	0	4	0	4	0	4	1	3	0	4
Igbo	4	0	4	1	3	1	3	1	3	0	4
Others	2	0	2	0	2	1	1	0	2	0	2
AGE	No tested	anti-C +ve	Anti C –ve	Anti E +ve	Anti E –ve	Anti K +ve	Anti K –ve	Anti k +ve	Anti k –ve	Anti Jsa +ve	Anti Jsa–ve
16-25	7	0	7	0	7	0	7	1	6	0	7
26-35	19	2	17	2	17	3	16	1	18	2	17
36-45	4	1	3	0	4	2	2	1	3	0	4
45-50	0	0	0	0	0	0	0	0	0	0	0
>50	0	0	0	0	0	0	0	0	0	0	0
Marital status	No tested	anti-C +ve	Anti C –ve	Anti E +ve	Anti E –ve	Anti K +ve	Anti K –ve	Anti k +ve	Anti k –ve	Anti Jsa +ve	Anti Jsa–ve
Single	3	1	2	0	3	0	3	0	3	0	3
Married	36	2	34	2	34	5	31	3	33	2	34
LEVEL OF EDUCATION	No tested	anti-C+ve	Anti C –ve	Anti E +ve	Anti E –ve	Anti K+ve	Anti K–ve	Anti k +ve	Anti k –ve	Anti Jsa+ve	Anti J–save
Secondary	14	2	12	2	12	3	11	3	11	1	13
Tertiary	9	0	9	0	9	2	7	0	9	1	8
Postgraduate	7	1	6	0	7	0	7	0	7	0	7

%[30]. Anti – K and anti- Ku are capable of causing severe haemolytic transfusion reaction while mild reactions is caused by anti- k, anti- kpa, anti- kpb, anti- Jsa, anti – Jsb[31]. 10% of the total population that had histories of pregnancy complications were positive for anti-k.

Anti- Jsa has the frequency of (2)13% in this study. Jsa has been reported to be common among people of African origin. Anti-Jsa was occurring frequently at the rate of 20% in the population, very rare in Caucasians and absent in Asian descendants and implicated in acute and delayed haemolytic transfusion reaction as well as haemolytic disease of the new born[32]. In this study, the frequency of anti-C was (3) 20% and anti-E (2) 13 %. Which is in correlation with work done on antenatal women by Jeremiah and colleagues in 2012 where the results of the frequency were anti-C to be 24.3% and anti-E to be 20.1%[4]. This finding was similar to other studies carried out by Jeremiah and colleagues, in 2005, Reid and Lomas in 2004[33,34]. They reported the following frequencies: Caucasians: D (85%), C (68%), E (29%), c (80%), and e (80%), Blacks: D (92%), C (27%), E (22%), c (96%) and e (98%), Asians: D (99%), C (93%), E (39%), c (47%), and e (96%).

HDFN caused by anti-C is usually mild as the C antigen has weak immunogenicity as scarcely reported by Daniel in 2005[35]. It is important that antibodies other than anti-D should be considered in cases that give a suggestive history but no evidence of Anti-D[36].

Anti-E can occur naturally as IgM antibody; however, IgG anti-E can be found in the

sera of pregnant women with a history of previous transfusions and pregnancies. This immune form of anti-E can cause a mild to moderate HDFN[37]. This brings the attention the necessity of introducing antibody screening for pregnant women as a routine for antenatal care to investigate significant allo-antibodies other than anti-D[38].

90% of total number pregnant women in the study were multigravidae as the primigravidae made up just 10% of the population. Among the total primigravidae and multigravidae, Kell antibodies were more prevalent in the multigravidae (5%) compared to the primigravidae (2%) whereas anti-C and anti-E were more prevalent in gestational mother with blood transfusion histories. HDFN is more severe if anti-K, immunisation is caused by prior pregnancies rather than by prior RBC transfusions[39].

The distribution of the phenotype of those antibodies detected among pregnant subjects was compared based on ethnicity. The prevalence of Kell antibody was significantly higher among the Yoruba ethnic group (66.6%) followed by anti-C and anti-E when compared to other ethnic groups that indicated zero prevalence ($p = 0.001$). Kell negative antibody screen was more among all the ethnic groups.

Shown in the table 5 was the prevalence of Kell antibodies among Pregnant women based on ethnicity. Anti-D, anti-C, anti-E, and anti-e have all been involved in hemolytic transfusion reactions, particularly delayed reactions[40]. When anti-C and anti-D are seen during a pregnancy, possibly anti-G is present. This observation is of relevance since women with anti-G can still develop anti-D and require Rh prophylaxis[41]. Since anti-c is involved in all cases of severe HDFN with histories of maternal RBC transfusion therefore, Rhc-compatible RBC transfusion has been extremely important in women younger than 45 years[42]. As such most gestational mothers in this study seemed to have terminated their educational status at the secondary level (47%) and no history of pregnancy complications was recorded in 90% of the total population studied. At the methodological level, improvement in rates among countries with low literacy is expected to have the same effect on maternal mortality as those countries at higher literacy rates.

The distribution of ethnic groups of gestational mothers in this Western part of Nigeria were majorly Yorubas as their population made up 67% of the study population followed by Igbo gestational mothers (13%) and Hausa (13%) gestational mothers

Conclusion

This study indicates a significant occurrence of red cell alloantibodies among pregnant women. It was observed that prevalence of Kell antibodies was consistent among subjects followed by Rh antibodies. Based on the study, it was concluded that most multigravidae subjects are prone to having red cell alloantibodies than the primigravidae. The overall incidence of red cell alloantibodies among gestational mothers in this area of study was generally estimated to be 12.2%. The current frequency of anti-E (13.3%), anti-C (20%), anti-K (33.3%) antibodies in subjects were clinically significant. The mother's immune system attacks the foreign antigens if present on the fetus red cells which can result to HDFN or can cause consequent Haemolytic transfusion reaction in the mother.

Therefore, it necessary that antibody screening on patients' samples prior to cross matching needs to be established in Ekiti state including all parts of the country to ensure safe child delivery and blood transfusion practice in gestational mothers.

Recommendation

It is recommended that routine screening of pregnant women in Ekiti state for clinically significant red cell antibodies should be performed to help in the management of Hemolytic Disease of Fetus and Newborn as well as the prevention of Haemolytic transfusion reaction.

Administration of K-, Rhc-, RhE-, and RhC- compatible RBC to all women of reproductive age as a preventive measure is recommended. There is a need for a constant update on health education of pregnant women in the Ekiti state to encourage timely booking for antenatal care and adherence to prescribed medication. Further studies propose that red blood cell clinically

significant phenotypes of patient are done before the commencement of transfusion therapy.

Conflict of interest

The authors declared that there is no conflict of interest.

Author's contributions

This work was carried out in collaboration among all authors. Nyong IC carried out laboratory analysis/experimental work, Oyetunde BA wrote the first draft, Kosamat YA reviewed literature, Adams EE edit manuscript. Olayanju AOD designed the protocol, supervised the research and edited the first draft. Okolo SC, performed literature search, editing and correspondence. All authors, read and approved manuscript.

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Conflict of interest

Authors have declared that no conflict of interests exist.

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