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ABO/Rh Blood Groups and Haemoglobin Electrophoretic Pattern Among Subjects of Ogoni and Ikwerre Ethnic Groups in Rivers State, Nigeria

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Abstract

This study assessed the ABO/Rh (D) and haemoglobin electrophoretic pattern among subjects of Ogoni and Ikwerre ethnic groups in Rivers State, Nigeria. A total of 200 randomly selected subjects comprising of 86 males and 114 females from Ogoni and Ikwerre ethnic groups in Rivers State, Nigeria were studied. Five millilitres of ethylene diamine tetra acetic acid (EDTA) anticoagulated blood was collected from each subject. The tile and tube methods were used for cell and serum grouping respectively while cellulose acetate paper electrophoretic method was used to determine the haemoglobin electrophoretic pattern of subjects under strict compliance to standard operation procedures. A significant number of Ogoni and the Ikwerre indigenes were blood group O⁺ (74% and 60% respectively). Blood group B⁺ was moderately higher among the Ikwerres (15%) compared to (11%) among the Ogonis. Group A⁺ was 21% amongst Ikwerres and 9% amongst the Ogonis. Group O⁻ individuals were lower amongst the Ikwerres (2%) and higher amongst the Ogonis (4%). Other blood groups such as B⁻ and AB⁺ had percentage frequency distribution of 1% each for both ethnic groups. AB⁻ was not found in any of the studied population. The haemoglobin electrophoresis pattern for HbAA, HbAS, HbSS, HbAC and HbSC were 72% in Ikwerre and 88% in Ogoni for HbAA, 28% in Ikwerre and 12% in Ogonis for HbAS, 0% for HbSS, HbAC and HbSC in both ethnic groups. This study provides adequate knowledge that majority of Ogoni

and Ikwerre indigenes are blood group O⁺ with normal Hb pattern HbAA. The incidence of sickle cell traits and sickle cell disease among subjects of both ethnic groups was significantly low indicating that persons of both ethnic groups can potentially intermarry with little or no significant risk of producing children with sickle cell disease amongst their offspring.

Keywords: ABO, Rhesus (D), blood groups, haemoglobin electrophoresis, haemoglobinopathy, Ogoni, Ikwerre, Rivers State, Nigeria.

Introduction

ABO/Rh (D) blood group and haemoglobin electrophoresis are some essential constituents of biological/genetic origin that is of great clinical significance in health. The ABO blood group antigens are of prime importance in transfusion medicine. They are the most immunologic of all the blood group system and appears to have been of importance in the evolution of humans. This is because the blood type differs among populations (Dean, 2005). The ABO blood group system is used to group or classify human blood based on the antigenic components present or absent on the red blood cell and their corresponding antibodies. Their identification is based on the presence or

absence of the A and B antigens on the surface of the red blood cell. This grouping system classifies the human blood into four types, blood type A, blood type B, blood type AB and blood type O. ABO is the most important blood group system in human blood transfusion and the antigens of the system can be found on the erythrocytes, platelet, epithelium and cells other than the erythrocytes. The ABO antigens (when it involves other serotypes) can lead to an adverse immune response to the organ transplantation (Muramatsu *et al.*, 2014).

The ABO blood group system has a central principle based on the fact that antigens (in this case sugars) that are physically exposed on the outer surface of the red blood cells are different from those individuals that have immunological tolerance only towards what occurs in their own bodies (Hara *et al.*, 2013). These groups can be seen as subtypes of ABO blood types that have most of the chemical properties of type A, B, or O, but have a slight difference in a portion of their structures that can be recognized through testing. Changes that result into these subtypes might have occurred through various mutations, such as single point mutations, amino acid substitution, frame shift mutations, single missense mutation and deletion. The extent to which the subtypes cause haemolysis is as a result of the amount of variation that exists between the individual constituents of the subtypes (Victoria, 2013).

The ABO blood group types are determined and named by antigens and their corresponding antibodies. These antibodies are glycoprotein built of the heavy and light chain subunits (Onuoha *et al.*, 2015) and are strong, reactive in nature and of the class of immunoglobulin M (IgM) antibodies usually present in the serum. These antibodies are produced in the first year of life due to sensitization of the individual to

the environmental substance such as bacteria, viruses and food (Hara *et al.*, 2013).

The antibody has region which lightly vary due to the amino acid sequence (variable portion) and the constant region. Antigens present on the surface of the red blood cell determines an individual's blood group and being surface markers are present on the membrane of RBCs. This makes the surface of the unique human cell type-erythrocyte, not to be as smooth as it appears on the extracellular surface but carries some uniform structures across its entire surface (Dean, 2005).

The antigens are made up of carbohydrate structures which are carried on substrate H antigen and the specific sugar to be added to the end of the H substance (Batissooco and Novaretti, 2003). ABO antigens A and B are immunodominant sugars with N-acetylgalactosamine and galactose respectively, and are synthesized by a series of reactions (Yamamoto, 2010). Most of the ABO antigens are expressed at the ends of long polygalactosamine chain that is mainly attached to the band 3 protein (an anion exchange protein), these anion exchange proteins and small of the epitopes are expressed on neutral glycosphingolipid (Benjamin, 2008).

The genetic basis of ABO blood group is an example of multiple allele with the ABO locus having the A, B and O alleles (Deans, 2005). The ABO genes in an individual's DNA are genes that codes for the specific glycosyltransferase enzyme which allows for antigen A and/or B to be added to the O antigen (Nelson and David, 2004). Failure of this gene to code for type A or type B transferase, will results in the individual belonging to the blood type O. These three amino acids make the gene that codes for N-acetylgalatosamine and



galactose transferase to differ from one another making a strong similarity to exist between these two enzymes and shows their relationship through divergent evolution (Nelson and David, 2004).

The A and B antigen on the red cell surface is synthesized by specific transferase encoded by ABO locus located on chromosome 9 (q34.1-q34.2) (Dean, 2005). This synthesis occurs in the presence of a precursor substance called H antigen and the H locus (FUT 1) is the locus that encodes the enzymes responsible for this H antigen synthesis process with the A antigen differing from B antigens by seven nucleotide substitutes (Geoff and Imelda, 2011; Yamamoto, 2010).

Blood groups are inherited by offspring from their parents following Mendelian rule for genetic traits. The determinants of ABO blood group system are the ABO genes located on chromosome 9 (Australian Red Cross Blood Service, 2016) and can be affected by factors such as difference in allele frequency, genetic drift, natural selection, mutation and migration (Olaniyan *et al.*, 2013; Perry *et al.*, 2012).

The Rh blood group system is one of the most complex blood groups found in humans. It is the second most important blood group system in blood transfusion medicine. It is the main cause of haemolysis and remains of basic importance in obstetrics (Dean, 2005). Currently Rh blood group contains about 50 defined blood antigens. Among all the number of antigens that exist in the Rh system, the most important are D, C, c, E and e (Reid and Lomas-Francis, 2004). Unlike the ABO, immunization against the Rh can generally occur through blood transfusion or placental transfer during pregnancy.

The Rh antigens are carried on the transmembrane protein. Their structure suggests that they are ions channels (Blood Group Antigen and Gene Mutation Database, 2010). The main antigens are D, C, E, c and e and these antigens are encoded by adjacent gene loci, the RHD gene which encodes the RhD protein with D antigen (and variants) (Blood Group Antigen and Gene Mutation Database, 2010). The RHCE gene encodes the RhCE protein which has the C, E, c, and e antigens (and variants).

The Rh phenotype can be easily identified by the presence or absence of the Rh antigen on the surface of the red cell produced by combination of different Rh gene types. With about 417 amino acids of protein combining together to forms the Rh antigens, the Rh genotype can be determined using DNA analysis. They cross the membrane 12 times and only small loop of the protein is found on the surface of the cell membrane (Ann, 2005). Therefore, Rh antigens are not as available to react with specific antibodies and there are fewer antigen sites than the way it is in ABO (Reid and Lomas-Francis, 2004). Rhesus antigens have no naturally occurring antibody rather all the Rh antibodies are immune in nature due to antigenic stimulation that is specific to that antibody (Ochei and Kolhatka, 2000). Some Rh antibodies cannot be detected in saline suspensions of red cell. However, when protein rich medium such as serum or albumin is used agglutination of the respective red cell can occur. These antibodies are called incomplete or albumin active antibody (Ochei and Kolhatka, 2000). The size of the antibody molecule is to a great extent very responsible for their reactivity. Haemoglobin forms the main component of RBC and it is essential chemical containing iron, used in transportation of oxygen (O₂) round the body (Sidell, 2006). Normal adult

haemoglobin molecule consists of two alpha(α)- and two non- α globin chains. This globin chain has an important component named haeme. Within this iron compound is an iron atom which is necessary for transporting oxygen and carbon dioxide in the body. The iron in the haemoglobin molecule is also responsible for red cell coloration (Charles and Williams, 2015). Some of the normal haemoglobin types are; haemoglobin A (HbA), which comprises of 95-98% of haemoglobin that is found in adults, haemoglobin A₂ (HbA₂), which is 2-3% of haemoglobin found in adults, and haemoglobin F (HbF), which is the primary haemoglobin produced in foetus during pregnancy but found in adult up to 2.5% (National Centre for Biotechnology Information, 2014).

The haemoglobin variants are mutant forms of haemoglobin in a population (usually of humans), which is caused by genetic variation. Haemoglobin variants are as a result of genetic changes in specific gene, or globin that causes alteration in the amino acid. These changes could affect the behavior, structure, production rate and / or how stable the specific gene will be (Johnson and Lavesa, 2012). Some of the variants are responsible for diseases and are considered as pathological variants while others have no detectable pathology attached to them and are considered as non-pathological variants (National Center for Biotechnology Information, 2014). The haemoglobin variants are most often inherited characteristics. First, there are abnormal genes, these genes can be inherited in an autosomal recessive, heterozygous or homozygous fashion. Severity of haemoglobin disorder is dependent on the genetic mutation, the copies of the abnormal gene that is inherited by the offspring and these vary from person to person (National Centre for Biotechnology Information, 2014).

There are three basic variant haemoglobin such as the HbF, HbA and HbS. Haemoglobin F (HbF) serves as the main oxygen transport protein in the foetus and in early life of a neonate. It is found in human foetus during the last seven months of their development in the uterus and persist until roughly 6 months after birth. In their function, foetal haemoglobin has the ability to bind to oxygen with greater affinity than that of adult forms, this gives the developing foetus a better access to enough oxygen (Lanzkron *et al.*, 2008).

Sickle cell haemoglobin (HbS) result when there is a defect in the beta chain of the globin molecule. The unusual or abnormal haemoglobin is usually present in people from the malaria zone of the world, for example Nigeria, Asia, the middle and far South America, Mediterranean Island and South America. Migration and inter marriage also make it observable in people who are not from the malaria zones of the world. Sickling trait, usually written as HbAS occurs when an individual inherits haemoglobin A from one parent and sickle haemoglobin S from the other. This trait is asymptomatic but might experience some complications of sickle cell disease (SCD) such as pain crises (although in rare cases) (Dean, 2005) and this trait can only be determined through a blood test. However, sickle cell disease that has severe complications can occur when an individual inherits one sickle cell haemoglobin from each parent. This will result in a clinical condition known as sickle cell anaemia (HbSS). Where the sickle haemoglobin is inherited alongside with another unusual haemoglobin, for instance, HbC, the individual will have sickle cell haemoglobin C disease (HbSC), if inherited with beta thalassaemia, sickle cell beta thalassaemia (HbS β^{thal}) will result (Bretns Sickle Cell Thalassaemia Centre, 2006). The hallmark



clinical manifestation of SCD is acute vaso-occlusive event or pain episode. This unique type of pain starts as early as 6 months of age, recur unpredictably over a lifetime and require treatment with opioid (Smith *et al.*, 2005). The distribution of haemoglobinopathy varies from one population to the other (Erhabor *et al.*, 2010; Akhigbe *et al.*, 2009; Jeremiah, 2006; Bakare, *et al.*, 2004).

Materials and Methods

Study Area/ Population

This study was carried out among subjects of Ogoni and Ikwerre ethnic groups in Rivers State in Southern Nigeria. A total population of 200 randomly selected subjects comprising of 86 males and 114 females from Ogoni and Ikwerre ethnic groups in Rivers State, Nigeria were recruited for the study.

Sample Collection and Preparation

Using a sterile needle and syringe, 5ml of fresh venous blood was collected from the subjects by venipuncture from the cubital fossa of the arm and put into ethylene diamine tetra acetic acid (EDTA) container with proper mixing to avoid clotting for blood grouping (cell and serum grouping) and haemoglobin electrophoresis.

Methods

Cell and serum grouping using tile/tube method as described by Ochei and Koltakar (2000) was used to assay for the various blood groups amongst the subjects studied while haemoglobin electrophoresis as described by Ochei and Koltakar, (2000) based on the principle that different types of haemoglobin have different migration rate due to its proteins and can be made to migrate towards the cathode or anode depending on the charges carried by the haemoglobin. Alkaline cellulose acetate is used in an alkaline buffer pH of 8.7, which tend to

make the negatively charge haemoglobin to migrate to the anode.

Results

The results obtained from the study are expressed in Tables with percentage frequency distribution for each ethnic group. The distribution of the subjects based on gender is shown in Table 1. Table 2 depicts the ABO blood group distribution among subjects of Ikwerre and Ogoni ethnic group. Tables 3 and 4 shows the percentage distribution of ABO/Rh blood group among subjects of Ikwerre and Ogoni ethnic group respectively while Table 5 depicts the percentage distribution of ABO/Rh blood group in the two ethnic groups studied.

Blood group O⁺ individuals had the highest percentage frequency of 74%, in Ogonis, 60%, in Ikwerres (Table 5). After group O⁺, the next blood group of a moderate percentage frequency of 21% is blood group A⁺ in Ikwerre which is 12% higher than 9.5% seen in the Ogonis for the same blood group. For group O⁻, Ikwerres had the least percentage frequency of 2% whereas the Ogonis had 4%. The Ogonis recorded 1% frequency for A⁻ whereas 0% was recorded for Ikwerres for the same blood group. The percentage frequency for blood groups B⁻ AB⁺ were 1% for each of the ethnic groups. AB⁻ was not found in any of the subjects studied from the two ethnic groups. A total percentage frequency for RhD positive blood group of 97% and 95% was recorded for Ikwerres and Ogonis respectively. RhD negative blood group was seen to be the least with percentage frequencies of 3% and 5% for Ikwerres and Ogonis respectively.

Tables 6 and 7 shows the percentage distribution of haemoglobin electrophoretic patterns among subjects of Ikwerre and Ogoni ethnic group respectively. The haemoglobin

electrophoretic frequency for HbAA, HbAS, HbSS, HbAC and HbSC were 72% in Ikwerre and 88% in Ogoni for HBAA, 28% in Ikwerre

and 12% in Ogonis for HBAS and no individual for HbSS, HbAC, HbSC electrophoretic pattern.

Table 1: Distribution of Subjects based on Gender

Gender	Ikwerre	Ogoni
Males	38	48
Females	62	52
Total	100	100

Table 2: ABO Blood Group Distribution of Ikwerre and Ogoni Ethnic Groups

Blood groups	Ikwerre	Ogoni
A	22	9
B	15	12
AB	1	1
O	62	78

Table 3: Percentage Frequency Distribution of ABO/Rh Blood Group of Ikwerre Ethnic Group

Gender	Group A		Group B		Group AB		Group O	
	A ^{+VE}	A ^{-VE}	B ^{+VE}	B ^{-VE}	AB ^{+VE}	AB ^{-VE}	O ^{+VE}	O ^{-VE}
Male	6	NIL	4	NIL	1	NIL	27	NIL
Female	15	1	11	NIL	NIL	NIL	33	2
Total	21	1	15	0	1	0	60	2
% Total	21	1	15	0	1	0	60	2

Table 4: Percentage Frequency Distribution of ABO/Rh (D) Blood Group of Ogoni Ethnic Group

Gender	Group A		Group B		Group AB		Group O	
	A ^{+VE}	A ^{-VE}	B ^{+VE}	B ^{-VE}	AB ^{+VE}	AB ^{-VE}	O ^{+VE}	O ^{-VE}
Male	4	NIL	8	1	1	NIL	31	3
Female	5	NIL	3	NIL	NIL	NIL	42	1
Total	9	0	11	1	1	0	74	4
% Total	9	0	11	1	1	0	74	4

**Table 5: Percentage Distribution of ABO/Rh Blood Group in the Two Ethnic Groups Studied**

Ethnic Group	Group A		Group B		Group AB		Group O		Rh Group	
	A+	A-	B+	B-	AB+	AB-	O+	O-	Rh+	Rh-
Ikwerre %	21	1	15	0	1	0	60	2	97	3
Ogoni %	9	0	11	1	1	0	74	4	95	5

Table 6: Percentage Distribution of Haemoglobin Genotype in Ikwerre Ethnic Group

Gender	HbAA	HbAS	HbSS	Total
Male	27(27%)	11(11%)	NIL	38
Female	45(45%)	17(17%)	NIL	62
Total	72(72%)	28(28%)	0	100

Table 7: Percentage Distribution of Haemoglobin Genotype in Ogoni Ethnic Group

Gender	HbAA	HbAS	HbSS	Total
Male	41(41%)	7(7%)	NIL	48
Female	47(47%)	5(5%)	NIL	52
Total	88(88%)	12(12%)	0	100

Discussion

From the study conducted on both ethnic groups, the distribution of ABO- Rh blood group varied in some blood groups while they were the same in others. The variation is in agreement with the studies conducted by other authors which shows that the distribution of ABO blood group varies from one population to

the other (Onuoha *et al.*, 2015; Olaniyan, *et al.*, 2013; Perry *et al.*, 2012).

Other studies conducted on ABO blood group have shown that blood group O has been found to be the most frequent of all the ABO blood types (Onuoha *et al.*, 2015; Olaniyan, *et al.*, 2013). The genetic segregation that is responsible for the ABO blood system seems to

always follow a particular pattern for its distribution with exceptional cases seen in a previous report by Pramanik and Pramanik (2000). Blood group AB has been seen to have the least percentage distribution from this study. This is in agreement with the findings of other authors on similar studies (Onuoha *et al.*, 2015; Olaniyan, *et al.*, 2013).

The distribution of RhD also varies among the blood group of human population. In this study it was observed that the total percentage frequency for RhD positive blood group was higher than RhD negative blood group in both ethnic groups. This is in agreement with the findings of other authors (Onuoha *et al.*, 2015; Olaniyan, *et al.*, 2013; Perry *et al.*, 2012). Studies has shown that over the years that the distribution of RhD negative has remained very low among any population (Onuoha *et al.*, 2015; Olaniyan, *et al.*, 2013; Perry *et al.*, 2012).

Haemoglobin electrophoretic pattern AA(HbAA) had the highest percentage frequency in both ethnic groups studied. This is in line with the findings of previous authors (Erhabor *et al.*, 2010; Akhigbe *et al.*, 2009; Jeremiah, 2006; Bakare, *et al.*, 2004). The frequency of sickle cell trait (HbAS) obtained from this study is also consistent with the findings of previous authors (Nwafor and Banigo, 2001; Jeremiah, 2006; Akhigbe *et al.*, 2009). The 0% frequency of HbSS recorded in this study is in agreement with work done by some authors in the Niger Delta region (Jeremiah, 2006). This possibly imply that the sickling gene pool is gradually reducing in some Nigerian populations due to increase awareness and pre-marital counselling. This could also be attributed to increased awareness of the disease, improved socio-economic conditions, environmental and genetic factor which have an overall effect on the sickling gene pool.

Blood group and haemoglobin electrophoretic pattern is of great significance in the health of an individual as the information obtained from the study can be useful in medical diagnosis, genetic counselling, and genetic information, for the wellbeing of the individual and in decision making.

In conclusion, it can be observed that majority of people from Ikwerre and Ogoni are of blood group O Rh. D positive having the normal haemoglobin pattern (AA). Although, there are individuals with the sickle cell trait among the randomly selected subjects. The sickle cell disease is not found (negligible) and the RhD positive blood is predominant in all the ABO blood types. Thus, indigene of these ethnic group can inter marry with little or no fear of having sickle cell children.

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