ABO/Rhesus Blood Group and Correlation with Sickle Cell Disease and Type-II Diabetes Mellitus in South East and South-South of Nigeria

Alagwu EA¹, Akukwu D², Ngwu EE¹, Uloneme GC²

¹Physiology Department, Faculty of Basic Medical Sciences, Imo State University - 460222, Owerri
²Anatomy and Neurobiology Department, Faculty of Medicine, Imo State University - 460222, Owerri

Abstract

Correlation between ABO/Rhesus blood group, Sickle cell disease (SCD) and Diabetes mellitus (DM) was investigated in Okwe, Asaba, Delta State and Ihiala, Anambra State, Nigeria. 100 proven cases of sickle cell patients (HBSS) from the sickle cell clinic in the General Hospital, Okwe, Asaba, Delta State, Nigeria, were studied. 200 normal individuals, 100 with genotype AA and 100 with genotype AS were taken as control for comparison from Okwe town. Furthermore, 50 proven cases of adults diabetic mellitus type2 from the diabetic clinic of our Lady’s of Lourdes Hospital Ihiala, Anambra State were studied. Samples of 50 normal adult individuals were taken from the Hospital town as control for comparison. In the ABO/Rhesus blood group and SCD, the result showed that there was a correlation between ABO/Rhesus blood group and sickle cell disease (p<0.05). It was also observed that blood group O has the highest frequency distribution among the sicklers (63%), followed by blood group B (20%), then blood group A (17%), the least was AB blood group with 0% distribution. For Rhesus blood system, the prevalence of Rh positive and Rh negative was studied against the hemoglobin genotypes. Rh positive was 96% for SS, 74% for AA, and 92% for AS. Rh negative was 4% for SS, 26% for AA and 8% for AS. This showed that Rh positive has the highest prevalence in SS while Rh negative has the lowest prevalence in SS. In ABO/Rhesus blood group and DM, there was no correlation between ABO/Rhesus blood group and adult type 2 diabetes mellitus (P>0.05). It was also observed that blood group O (78%) was most commonly distributed in diabetes mellitus type2, followed by A (22%), blood group 0 (0%) and AB (0%) did not show any incidence of type2 diabetes mellitus. When Rh positive and Rh negative where matched against DM and the control, Rh positive was 94% in DM and 88% in control (P>0.05). Rh negative was 6% in DM and 12% in control, (P>0.05). It was observed that Rh positive was more in DM than the control, and Rh negative was more in control than in DM patient. Therefore, correlation between ABO/Rhesus blood group and diabetes mellitus type 2 was not proven. It is accordingly, concluded that ABO/Rhesus blood group has positive correlation with sickle cell disease and fell short of such correlation with diabetes mellitus.

1 Introduction

Correlation between ABO blood group, SCD and DM was studied in Asaba Delta State and in Ihiala, Anambra State, Nigeria. ABO blood groups are groups of antigens, located on the cell membrane, coded by alleles at different loci on the chromosome molecules, and classified into blood groups, A, B, AB and O. Blood groups of individuals depend upon the presence or absence of two genes, A and B, and are expressed on the end of long polylactosamine chains. Individuals are all divided into 4 major blood groups namely A, B, AB and O blood groups depending on the antigen present on the red cell.
membrane. Study in Nigeria showed that blood group O is the most common, followed by A, B, and least in AB with over 95% of Rhesus positive and 5% of Rhesus negative. A blood group has natural antibodies B in the plasma, B has antibodies A, AB has no antibodies in their plasma while 0 blood group has both A and B antibodies in the plasma. Sickle cell disease is the most prevalent hemoglobinopathy in human population. It is genetically transmitted in a recessive form. It is an inherited disorder/disease. WHO (2010) reported that 2% of new born in Nigeria were affected by the disease with a total of 150,000 affected children born every year in Nigeria. Hemoglobin genotypes are inherited characters determined by different combination of these chains which include HbAA, HbAS, HbSD, HbSE and HbSS. HbSS differs from HbAA by the substitution of valine, a neutral amino acid for glutamic acid at position 6 in the Beta polypeptide chain. DM is a disease characterized by impaired carbohydrate, fat and protein metabolisms caused by either lack of insulin secretion or decrease sensitivity of tissues to insulin, resulting in hyperglycemia in the blood. Three types of DM exist namely, Type1, Type2 and Type3.

Type 1 is juvenile onset diabetes also called insulin dependent DM. Type2 is adult onset DM which results in inability of the body to utilize insulin produced by the body effectively or deficiency production by the Beta cells of the pancreas. Type3 is gestational diabetes which usually disappears after pregnancy. WHO recommended for normal person fasting blood glucose of 70-110mg/dl as normal. In Nigeria with over 140 million people according to 2006 population census, it was estimated that 6 million people have full blown diabetes mellitus. 1992, natural prevalent study on non-communicable disease conducted by the Federal Ministry of Health, on 13 states of the federation indicated prevalence of 2.7% in adult female. DM etiology is complex but factors like genetics, habit, immunological and environment may be involved. But has genetic and familial predispositions, although environmental factors do play their role in the genetic expression. WHO, defined DM as a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively utilize the insulin it produced. Insulin is a hormone produced by the pancreas that regulates blood sugar. It is known that ABO/Rhesus blood group and SCD are genetically transmitted/inherited while DM has familial tendencies and predisposition. There are conflicting reports about the correlations between ABO/Rhesus blood group, sickle cell disease and diabetes mellitus. Yamamoto 2003 reported relationship between diabetes mellitus and Rhesus blood group as inconsistent. Rhman 1976 described that there is no association between ABO blood group and type2 diabetes mellitus. Nemuse and Hennis stated that the incidence of diabetes mellitus was not associated with the distribution of the ABO blood group. However, reported association between ABO blood group and diabetes mellitus. Huston et al, 2002 reported association between a particular ABO genotype and increased susceptibility to certain diseases. Homozygote dominance (HbAA) is reported to be most susceptible to plasmodial parasite infection than sickle cell heterozygote (HbAS). Sickle cell homozygote (HbSS) is most vulnerable to malaria infection than the other members of the genotypes. Blood group O is reported to have selective advantage against malaria infection.

The present study was therefore, under taken to investigate and elucidate whether there is a correlation between ABO blood group, sickle cell disease and diabetes mellitus and also to determine which ABO blood group is prevalent in SCD and DM.

2 Materials and methods

2.1 Materials

Materials used in this study included blood, stock sera (anti-A and anti B, and anti D), EDTA containers, sodium fluoride, 2ml and 5ml syringes, glucometer, microscope, tourniquet, tiles, clean slides, cotton wool, hand gloves, sodium dithionite, spirit.

2.2 Experimental protocol

All the patients in the study were seen in the General Hospital Okwe, Asaba, Delta State and Our Lady of Lourdes Hospital Ihiala, Anambra State. Blood was collected and put in the sample bottles for the study. 100 patients with sickle cell disease were randomly selected from the Hospitals sickle cell unit, Okwe, Asaba. 100 healthy individuals were randomly selected from the town. They were identified as being healthy if their genotypes are AA or AS. 50 patients attending diabetic outpatient clinic of our Lady of Lourdes Hospital were randomly selected and were under treatment for DM. 50 healthy individuals were randomly selected from the hospital town. None has received any diabetic medication since live. They were identified also as being healthy if their venous blood glucose values were between 70 mg to 120 mg/dl. The anti-sera were qualified to ensure that they were genuine for accurate and reliable results. Blood samples were collected by venopuncture with 5 ml syringe and emptied into EDTA bottle and 2 ml fixed in a fluoride bottle. Blood sample in the EDTA bottles were used for blood grouping and sickling test while those in the fluoride bottles were used for random fasting blood sugar estimation as they did not take their morning meals. Blood group was done serologically; sickling test was done by making a blood smears using reducing agent, sodium dithionite. Blood smears were examined under microscope using x3 eye piece. Sickle red cells were observed. Blood sugar estimation was carried out with glucometer. Sugar strip was inserted into one strip glucometer, a drop of blood was placed on the sample spot. The meter issues results in mg/dl after 45 seconds.

2.3 Statistical analysis
The data were analyzed using Chi-square test, values greater than 0.05 on the Chi-square distribution table is not significant, while values less than 0.05 on the Chi-square distribution table is statistically significant.

3 Results

Table 1 shows the distribution of the ABO blood groups among diabetes and non-diabetes. 50 patients with DM were studied in relation to the ABO blood group distribution. Blood group A is more common (22%) in patients than the control (20%). Blood group B is found to be absent (0%) in patients and common in control (10%). In AB phenotypes, both the patients and the control were zero percent. But in blood group 0, it is more numerous (78%) in patients than in control (70%). These differences between them are however not significant statistically (P>0.05).

Table 1: Distribution of the ABO blood groups among diabetes and non-diabetes

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of patients</th>
<th>A Phenotype</th>
<th>B Phenotype</th>
<th>AB Phenotype</th>
<th>O Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic</td>
<td>50</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>%</td>
<td>-</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>78</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>50</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>%</td>
<td>-</td>
<td>20</td>
<td>10</td>
<td>0</td>
<td>70</td>
</tr>
</tbody>
</table>

There is more blood group O in diabetics, and non-diabetics control. The difference between diabetes and non-diabetes control is not significant, P>0.05.

Table 2 shows distribution of Rhesus factor between patients and non-diabetic control with Rhesus positive more in patients than the control (94% and 88%, respectively). In Rhesus negative, the diabetes and non-diabetes control are 6% and 12%, respectively. In comparison, Rhesus positive is more common (94%) in patients than control (88%) and Rhesus negative less common in patients (6%) than control (12%). These differences are however not significant statistically, (P>0.05).

Table 2: Distribution of Rhesus factor between patients and non-diabetic control

<table>
<thead>
<tr>
<th>Rhesus factor</th>
<th>Diabetics patient</th>
<th>Non-diabetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhesus positive</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>Rhesus + %</td>
<td>94%</td>
<td>88%</td>
</tr>
<tr>
<td>Rhesus negative</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Rhesus - %</td>
<td>6%</td>
<td>12%</td>
</tr>
</tbody>
</table>

x² = 1.099, df - 1; P>0.05

Table 3 shows the distribution of gender (sex) between patients and control. Females are found to be more in patients (62%) than in control (54%). Also it is found to be less for patients in males (38%) and more in control (46%). The distribution is not statistically significant P>0.05.

Table 3: Distribution of sex among diabetics and control (non-diabetics)

<table>
<thead>
<tr>
<th>Sex</th>
<th>Patient</th>
<th>Control non-diabetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>%</td>
<td>62%</td>
<td>54%</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>%</td>
<td>38%</td>
<td>46%</td>
</tr>
</tbody>
</table>

x² = 0.856. df - 1; P>0.05

Table 5 shows distribution of ABO blood group among sicklers (HbSS) and HbAA genotype individuals. Blood group A is more in normal individuals (33%) and less in sickle s(17%), blood group B is the same for both groups (20%). Blood group AB is absent in sickles (0%) and present in normal individuals (3%). But blood group O is more in patients (63%) and less in normal (AA) individuals (44%). This distribution is statistically significant (P<0.05).

Table 6 shows Rhesus factors distribution among sickles (SS) and normal individuals (AA & AS). Rhesus positive individuals are more patients (97%) and less in control (AA and AS; 74% and 92% respectively). Rhesus negative individuals are less in patients (4%) and more in controls (AA and AS; 25%AND 8%, respectively). These differences are statistically significant.
Rhesus positive is higher in a sickler than the control (p<0.05). Rhesus negative is less in a sickler than the normal individual.

Table 4: ABO blood group distribution of sickle cell disease patients, sickle cell carriers AS and genotype AA individuals

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Number</th>
<th>Blood group A</th>
<th>Blood group B</th>
<th>Blood group AB</th>
<th>Blood group O</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>100</td>
<td>33%</td>
<td>20%</td>
<td>30%</td>
<td>44%</td>
</tr>
<tr>
<td>AS</td>
<td>100</td>
<td>21%</td>
<td>14%</td>
<td>1%</td>
<td>64%</td>
</tr>
<tr>
<td>SS</td>
<td>100</td>
<td>17%</td>
<td>20%</td>
<td>0%</td>
<td>63%</td>
</tr>
</tbody>
</table>

X^2 = 15.15, df = 6; P>0.01 <0.025, P<0.05

Table 5: Distribution of ABO blood group among sicklers (HbSS) and HbAA genotype individuals

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Blood group A</th>
<th>Blood group B</th>
<th>Blood group AB</th>
<th>Blood group O</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>33%</td>
<td>20%</td>
<td>3%</td>
<td>44%</td>
</tr>
<tr>
<td>SS</td>
<td>17%</td>
<td>20%</td>
<td>0%</td>
<td>63%</td>
</tr>
</tbody>
</table>

X^2 = 11.484, df = 3; P<0.05

Table 6: Rhesus factors distribution among sickles (SS) and normal individuals (AA & AS)

<table>
<thead>
<tr>
<th>Rhesus factor</th>
<th>SS</th>
<th>AA</th>
<th>AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>+VE</td>
<td>96%</td>
<td>74%</td>
<td>92%</td>
</tr>
<tr>
<td>-VE</td>
<td>4%</td>
<td>26%</td>
<td>8%</td>
</tr>
</tbody>
</table>

X^2 = 24.828, df = 2; p<0.01

4 Discussions

Blood group distribution among different population groups is an important consideration in health care\(^5\). Studies in Nigeria have revealed that ABO blood group distribution is in the following order O>B>A>AB, i.e., blood group O is most distributed and AB blood group is least distribution. The present study investigated the ABO blood group distribution among the sicklers and the diabetics patients to find out whether there is a correlation between them. This study was also extended to the Rhesus factor. The result showed that blood group A has 33% of HBAA. Genotype, 21% of HBAS and 17% of HBSS, blood group B has 20% of AA genotype, 14% of AS genotype, and 20% of SS genotype.

Blood group AB has 3% of AA genotype 10% of AS genotype, and 0% of SS genotype. Blood group O has 44% of AA genotype, 64% of AS genotype and 63% of SS genotype. In rhesus blood group, the prevalence of rhesus positive among the patients of SS genotype and controls AA/AS are 96% and 74%/92% respectively. This showed that RHD positive is highly prevalent in AA/AS (Control). In RHD negative, sickle cell disease (SS) prevalence is 4%, AA was 26% and AS was 8%.

The result showed that RHD positive among the sicklers is higher than the control (AA/AS), P>0.05. The RHD negative sicklers are lesser compared with the control [AA/AS] P<0.05. In diabetics, blood group A is 22%, B is 0%, AB is 0% and 0 is 78%. In non-diabetic subjects taken as control, blood group A is 20%, B is 10%, AB is 0% and 0 group is 70%. It showed therefore that in diabetics, blood group O is most commonly distributed with it, followed by A. Blood group B and AB did not show any incidence of diabetes. The results were close to those carried out in Algeria population by Zaoui et al, 2007\(^7\), and Ruffie et al, 1962\(^8\) and South East Nigeria by Okon et al, 2008\(^9\). Also, O and A blood group individuals are reported to be more susceptible to diabetes mellitus. On blood group and sickle cell disease, the study showed that blood group O is most commonly associated with genotype SS (SCD), followed by blood group B, then A group and the least prevalence is AB.

The gene frequencies in respect to ABO blood group can easily be shown as O>B>A>AB. Blood group B and AB did not show any incidence of diabetes. The results were close to those carried out in Algeria population by Zaoui et al, 2007\(^7\), and Ruffie et al, 1962\(^8\) and South East Nigeria by Okon et al, 2008\(^9\). Also, O and A blood group individuals are reported to be more susceptible to diabetes mellitus. On blood group and sickle cell disease, the study showed that blood group O is most commonly associated with genotype SS (SCD), followed by blood group B, then A group and the least prevalence is AB.

Also, O and A blood group individuals are reported to be more susceptible to diabetes mellitus. On blood group and sickle cell disease, the study showed that blood group O is most commonly associated with genotype SS (SCD), followed by blood group B, then A group and the least prevalence is AB.

In gender distribution between diabetics and non-diabetics, it was observed that females were found to be more in patients (62%) than in control (54%). Also it was found to be less for patients in males (38%) and more in control (46%). Statistically, the distribution is not significant p>0.05. This study therefore showed significant correlation between ABO/Rhesus blood group and sickle cell disease while it failed to show significant association/correlation between it (ABO/Rhesus blood group) and type 2 diabetes mellitus. It is therefore concluded that ABO/Rhesus blood group has correlation with sickle cell disease (P<0.05) and genomic expression is in this order - O>B>A>AB. Rhesus positive blood group is also more prevalent in sickle cell patients than the control and Rhesus negative is less prevalent in sickle cell disease than the control. The association between ABO/Rhesus blood group phenotype frequency distribution and type2 diabetes mellitus is not proven. (P>0.05). It is therefore concluded that ABO/Rhesus blood group has correlation with

UK J Pharm & Biosci, 2016: 4(5); 81
sickle cell disease and its correlation with diabetes mellitus was not proven.

5 Conclusion

The present study was conducted to justify the ABO/Rhesus blood group was interrelated with SCD and DM. The findings imply that ABO/Rhesus blood group has positive correlation with sickle cell disease and fell short of such correlation with diabetes mellitus.

6 Conflict of interests

Authors have declared that no competing interests

7 Author’s contributions

EAA and UGC carried out literature review and experimental. NEE was responsible for statistical work and calculations in addition to manuscript proofing. AD collected the data and gained patient approval. All authors read and approved the final manuscript.

8 References

16. Tregouet DA, Health S, Saul M. Common susceptibility alleles are unlikely to contribute as the FV and ABO loci on VTErisk: Results from a GWAS approach. Blood. 2009; 113(21): 5298-5303.