



THE FREQUENCY OF ABO BLOOD GROUPING AND RHESUS ANTIGENS AMONG SUDANESE BLOOD DONORS

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ABSTRACT

Back Ground: ABO and Rhesus (Rh) blood group antigens are hereditary characters and are useful in population genetic studies, resolving medico-legal issues and more importantly in pre-transfusion testing in blood banking practice. Relatively little information is available regarding the frequency of the ABO and various Rhesus antigens among Sudanese population. The study was aimed to determine the frequency of those antigens among the Sudanese blood donors. **Material and Methods** The Study was descriptive cross sectional study, performed during May and July 2013. A total of 385 male blood donors attending Al-amal Hospital from different Sudanese ethnic groups was included in this study. The blood samples collected into EDTA containers and tested for the ABO and Rhesus typing by classical slide and tube agglutination method using commercially available anti-sera and gel micro typing system. Data were analyzed using SPSS software computer program version 21. **Result:** Blood group (O) was the most predominant blood group (47%), followed by blood group A (30.9%), B (17.9%) and AB (4.2%). Majority of the subjects were Rh (D) positive (93.5%) and only (6.5%) were Rh negative. The predominant Rh antigen after Rh D was Rh e⁻ (93.2%) followed by c⁻ (81.6%), C (38.4%) and E (16.9%). the most common phenotype in Rh D positive samples was ccDee(42.1%) and in RhD negative it was ccdee (5.2%). Seven samples were negative for antithetical antigens E and e while five samples negative for C and c antigens. The most probable genotype was cDe/cDe (42.1%). **Conclusion** concluded that the frequency of the Rh antigens can be shown in this order D > e⁻ > c⁻ > C > E. Special precautions need to be undertaken to minimize any possible allo-immunization by such antigens.

KEYWORD:- ABO and Rhesus (Rh) blood group possible allo-immunization by such antigens.

INTRODUCTION

Thirty blood group systems consisting of approximately 700 erythrocyte antigens are described by the International Society of Blood Transfusion.^[1] The ABO and Rhesus (Rh) blood group antigens remain the most important and famous blood group systems clinically and are the most frequently studied genetic markers in a large group of people.^[2] The ABO blood group system was first discovered in 1900 by Landsteiner.^{[3][4]} The Rh system was later described by both Landsteiner and Weiner in 1940 by their joint work.^[4] The ABO blood groups hold a respectable position in view of the safety of blood/blood products transfusion up to date.^[5] Rh system emerged as second most important blood group system due to hemolytic disease of newborn and its importance in Rh D-negative individuals in subsequent

transfusions once they develop Rh antibodies.^[6] The ABO blood group system is the only system in which antibodies are consistently, predictably and naturally present in the serum of normal individuals whose red cells lack the antigens.^[7] These ABO antibodies are usually IgM in nature and cause the intravascular hemolysis in ABO mismatch transfusions. ABO IgM antibodies are produced in the first years of life by sensitization to environmental substances such as food, bacteria. The importance of Rh blood group system is because of immunogenicity, polymorphism and complexity of its antigens. Unlike the situation with anti-A and anti-B antibodies, anti-D antibodies are only seen if a patient lacking D antigen is exposed to D +ve cells and are commonly IgG antibodies. The exposure of D +ve cells usually occurs through pregnancy or

transfusion. The knowledge of the distribution of ABO and Rh blood groups is essential for effective management of blood banks inventory, be it a facility of a smaller local transfusion service or a regional or national transfusion service.

Blood group antigens play a vital role in transfusion safety, genetics understanding, inheritance pattern, and disease susceptibility^[8] The benefit of knowledge of the blood group pattern in transfusion services is the reducing of maternal mortality rate and useful in clinical practice, because in certain conditions an antigen may react with its corresponding antibody and cause serious clinical effects like haemolytic disease of the newborn and haemolytic transfusion reaction.^[9]

Blood group antigens are known to have some association with diseases like duodenal ulcer, diabetes mellitus, urinary tract infection, Rh incompatibility and ABO incompatibility of newborn.^[10] The incidence of ABO and Rh groups varies markedly in different races, ethnic groups in different part of the world.^[11] Apart from their importance in blood transfusion practice, the ABO and Rh blood groups are useful in population genetic studies, researching population migration patterns, as well as resolving certain medico-legal issues, particularly of disputed parentage. It is, therefore, imperative to have information on the frequency of these blood groups in any population group. The Rh blood group has been reported to be the most complex and highly polymorphic of all the blood group systems.^[12] To the present, the Rh system is composed of over 50 antigens, but **D**, **C**, **c**, **E** and **e** are the most commonly identified and the most significant antigens in blood transfusion. Both Hemolytic Disease of the fetus and Newborn and Hemolytic Transfusion Reactions can occur due the various Rh antibodies. Anti-D causes the most severe form of HDN and it used to be a major cause of fetal death. Anti-c Rh alloantibodies are also capable of causing severe HDN.^[13] which is considered the most important Rh antigen after the D antigen. Rh allo-antibodies that are associated with mild HDN include anti-C.^[14] anti-E.^[15] and anti-e.^[16] Anti-D, anti-C, anti-E, and anti-e have all been involved in delayed hemolytic transfusion reactions.^[17]

Routine Rh D phenotyping in both blood donors and recipients has reduced the incidence of transfusion reactions caused by anti-D but sensitization to other Rh antigens can be a problem in transfusion medicine, particularly in patient who needs multiple blood transfusions.

The present study was carried out to determine the frequencies of ABO and various Rh antigens among the blood donors attending the Alamal Alwatani Hospital in Khartoum State in order to minimize any possible allo-immunization against various Rh antigens among the blood recipients.

MATERIALS AND METHODS.^[19]

The frequency of ABO and Rh blood groups was studied among 385 male blood donors from different Sudanese tribes when they attended for the donation process in the Alamal Alwatani Hospital in Khartoum.

The study was conducted between May and July 2013, ABO and Rhesus D, E, e⁻, C and c⁻ phenotyping was done by commercial reagent kit. Forward ABO grouping was performed by conventional slide and tube method and by Gel technology. For forward ABO grouping, commercially available monoclonal IgM blood group antisera (Anti-A, Anti-B) were used (Labkit, Barcelona, Spain). Gel card was also used when required.

Rh D typing was done by slide method using a monoclonal/polyclonal IgM/IgG anti-D (Labkit, Barcelona, Spain), confirmation of Rh D negative was done by the dextran acrylamide gel technique (Dia MED-ID Micro Typing System).^{[18],[19]} For detection of the major antigens of Rh system Antigen C, c, E and e specific monoclonal antisera anti C, c, E, e were used and test was performed by slide method. According to the manufacturer's instructions, a drop of EDTA blood was added to a drop of appropriate antisera and mixed gently. Agglutination results were recorded within 2 minutes. In case of doubt the test was examined under a microscope.

All statistical analysis was done by means of SPSS (Statistical Package for Social Sciences), then presented in tables and figures using Microsoft office word and excel.

RESULTS

Moreover the frequency of ABO blood group in 385 cases were O (47%), A (30.9%), B (17.9%) and AB (4.2%) (Figure1). Blood group O is found to be most common followed by A, B and AB. Incidence of Rh, D positive were 93.5% while 6.5% were Rh D negative. Furthermore the Frequency percentages of five major Rh antigens was D (93.5%), C (38.4%), E (16.9%), c (81.6%) and e (93.2%) (Fig.2). Out of 18 possible phenotype combinations, the most common phenotypes was ccDee (42.1%) while in Rh D negative samples it was ccdee (5.2 %), and could not detect any case of phenotype CcDEE , CCdEE , ccdEE and CcdEE In 12 (3.1%) samples we reported deletion of antithetical antigen E/e (7 cases), C/c (5 cases). In our study the most common probable genotype was cDe / cDe (42.1%) followed by CDe/cDe (17.3 %) (Table.2).

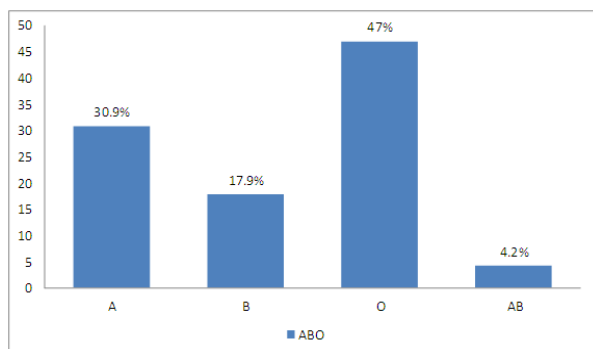


Figure 1: The Frequency of ABO blood groups among the studied blood donors

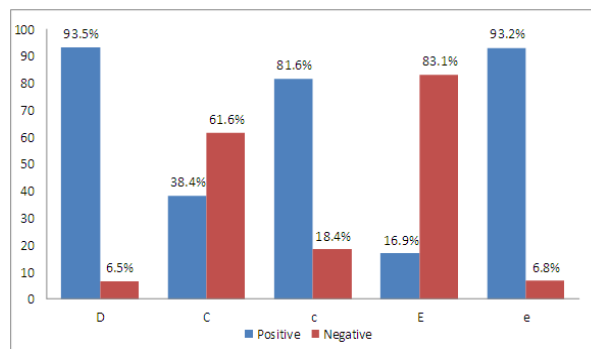


Figure 2: The frequency of Rh antigens among the studied blood donors.

Table 1: The frequency of ABO and Rh antigens among the studied blood donors in relation to their tribes.

	A	B	O	AB	D	C	c	E	e
Afro-asiatic	32.2%	17.5%	45.2%	5.1%	93.6%	36.6%	84.1%	18.5%	92.7%
Nilo-sahara	24.2%	18.9%	56.9%	0%	91.3%	48.3%	68.9%	12.1%	94.8%
Niger-congo	30.8%	23.1%	46.1%	0%	100%	38.5%	76.9%	0%	100%

Table 2: Phenotype and possible genotypes in the present study

	Phenotype	Possible Genotype	Frequency	Percentage
1	---De`e`	-De`/-De` , -De`/-de`	4	1.0%
2	---DEE	-DE/-DE , -DE/-dE	1	0.3%
3	c`c`d--	c`d-/ c`d-	1	0.3%
4	c`c`D--	c`D-/ c`D- , c`D-/ c`d-	4	1.0%
5	c`c`de`e`	c`de`/c`de`	20	5.2%
6	c`c`De`e`	c`De`/ c`De` , c`De`/ c`de`	162	42.1%
7	c`c`DEE	c`DE/c`DE , c`DE/c`dE	16	4.2%
8	c`c`dEe`	c`dE/c`de`	1	0.3%
9	c`c`DEe`	c`DE/c`De` , c`DE/c`de` , c`De`/c`dE	28	7.3%
10	Cc`de`e`	Cde`/c`de`	1	0.3%
11	Cc`De`e`	CDe`/c`De` , CDe`/c`de` , Cde`/c`De`	67	17.3%
12	Cc`dEe`	CdE`/c`de` , Cde`/c`dE	1	0.3%
13	Cc`DEe`	CDE/c`De` , c`DE/CDe` , CDE/c`de` , CdE`/c`De` , Cde`/c`dE , c`dE/CDe`	14	3.5%
14	CCD--	CD-/CD- , CD-/Cd-	2	0.5%
15	CCde`e`	Cde`/Cde`	1	0.3%
16	CCDe`e`	CDe`/CDe` , CDe`/Cde`	57	14.8%
17	CCDEE	CDE/CDE , CDE/CdE	3	0.8%
18	CCDEe`	CDE/CDe` , CDE/Cde` , CdE`/CDe`	2	0.5%
Total			385	100%

DISCUSSION

There is few published work in the literature regarding the frequencies of various Rh antigens among Sudanese population. Therefore, this study was performed to document the frequencies of the various Rh antigens among the blood donors in Alamal Alwatani hospital in Khartoum.

The present study revealed that, the blood group O was the most common followed by A, B and AB and this were found to be agreed to the study done by Fathelrahman Mahdi Hassan in 2010 on Major Sudanese Ethnic Groups^[20], also the findings agreed with study done in Bangladesh by Talukder SI, Das RK in 2010

which have been done on 500 males and females.^[21] but disagreed with study done by M.D. Gajjar, Darshan Adulkar et al from India whom found that the Blood group B has the highest prevalence (35.81%) in the population under study followed by O (32.74%), A (22.68%) and AB (8.77%).^[22] and that's could be due to ethnic variation between Indian and Sudanese population.

The frequency of the five major Rh antigens in the present study was D 93.5%, e 93.2%, c 81.6%, C 38.4%, and E 16.9% and it can be shown as in this order D > e > c > C > E. This frequency is in concordance with the study done at the central blood bank in 2012 on 200

blood donors by Waleid M. Shahata, Hiba B. Khalil *et al.* [23]. In Asians, Rh antigens are found to have higher frequencies except for Rh c, E.^[24], while it was D-85%, C-68%, E-29%, c-80% and e-98% in European countries ($e > D > c > C > E$).^[24] Study conducted by Jenan Y Taha.^[25] from UAE reported that most frequently occurring antigen was found to be e (97.3%), followed by D (91.1%), C (73.2%), c (71%) and E (21%), while Thakral *et al.*^[26] from north India, amongst Rh antigens, e was the most common (98.3%) followed by D, C (84.76%), c (52.82%) and E (17.9%). Younis Abed EL.^[27] from Palestinians reported that the percentage of Rh antigens; D+, D-, C, c, E and e in the total sample was 92%, 8%, 69%, 81%, 38% and 97%, respectively, while Jeremiah ZA *et al.*^[28] observed that most frequently occurring antigen was c (99.8%) followed by e (98.7%), D-(95%), E (20.5%) and finally C (17.7%). [Table 3].

The five major Rhesus antigens are the cause of most allo-immunizations following blood transfusion. So,

whenever we transfuse blood, it is crucial to provide Rh compatible blood especially in transfusion - dependent patients and women of reproductive age. In the present study, our results revealed that Rh E antigen has the least frequency among other various Rh antigens. Because of its immunogenicity, in certain circumstances as in case of transfusion-dependent patients this antigen may be a source for allo-immunization, so some precaution needs to be undertaken in order to prevent the consequent harmful effect of alloimmunization.

In our study most common phenotype was ccDee (42.1%) in Rh positive samples, while in Rh negative samples the phenotype ccdee (5.2%) was the most common one. Most common frequency reported in white was CCDee (42%) while it was ccDee in black (44%).^[24] No sample of Rh null was reported in present study while in 12 samples deletion of antithetical antigen E/e (7 samples), C/c (5 samples) was found.

Table 3: Comparison of frequency of five major Rh antigens at different geographical areas (in Percentage)

Rh antigens	Frequency in present study (%)	Asians	Europe	Palestinians	Nigeria	North Indians	UAE
D	93.5	99%	85%	92%	95%	84.7%	91.1%
C	38.4	93%	68%	69%	17.7%	84.7%	73.2
E	16.9	39%	29%	38%	20.5%	52.8%	21%
c	81.6	47%	80%	81%	99.8%	17.9%	71%
e	93.2	96%	98%	97%	98.7	98.3%	97.3

CONCLUSION

It was concluded through our study that the frequencies percentages of the Rh antigens were $D > e > c > C > E$ Rh D has Most frequent antigen amongst five major antigens of Rh system while the least common was antigen E The most common phenotype was ccDee while the most frequent probable genotype was cDe/cDe. Some of the Rh antigens have high immunogenicity; for this need to be checked along with antibody screening and their identification prior to transfusion to patients with the history of multi transfusion or multi-parity in females in transfusion practice to minimize any possible alloimmunization.

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