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Clinically significant minor blood group antigens amongst South Indian donor population

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Abstract

Background and objectives: Distribution of blood group antigen varies among different races. It is important to know the distribution of these antigens so as to provide a donor database that aid in providing compatible blood units for patients with multiple alloantibodies. The present study was conducted to determine the distribution of clinically significant minor blood group antigens amongst the South Indian blood donors.

Materials and methods: Blood samples were collected from healthy regular repeat voluntary blood donors of same ethnicity attending a tertiary care hospital in South Kerala. Clinically significant blood antigens of the ABO, Rh (D, C, c, E, and e), Kell, Duffy and Kidd blood group systems were determined. The ABO and Rh(D) grouping were performed by tube technique using monoclonal antisera. Column agglutination technique was used to phenotype Rh, Kell, Duffy and Kidd antigens.

Results: Total 200 healthy repeat voluntary blood donors were enrolled in the study. Out of 200 donors, 92% were RhD positive. Among the Rh antigens, the e antigen was positive in 97.8 % and 100% among the Rh(D) positive and Rh(D) negative donors respectively. No E antigen was detected in RhD negative donors. Total 6 and 2 Rh phenotypes were observed among the Rh(D) positive and negative donors respectively. R1R1 and Rr were the most frequent phenotypes among the RhD positive and negative donors (47.28% and 93.75%) respectively. Among the Kell blood group antigens, K and Kp^b antigens were present in 100% of our donors while in Duffy and Kidd system Fy^a and Jk^a were most predominant (89% and 87%) respectively.

Conclusions: The findings of the present study would be helpful in developing in-house panel cells. Moreover, a rare donor registry of donors typed negative for a high-frequency antigen can be formulated.

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Introduction

The blood transfusion requirement for the treatment of haemoglobinopathies in India is on an increase at a rate of 30 units per patient annually [1]. These chronically transfused patients develop clinically significant antibodies which can result in hemolytic transfusion reactions and haemolytic disease of fetus and newborn. The traditional practice is to provide antigen-negative blood when an antibody against a blood group system has been formed [2]. In these patients it is really tedious to find a compatible unit, especially if multiple

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antibodies have been formed in the patient. The situation can be worsened if an emergency transfusion is required.

There are currently 44 recognised blood group systems containing 354 red cell antigens [3]. There exists racial and ethnic differences in blood group antigen distributions [4-7]. There is very little information available regarding distribution of various clinically significant minor blood group antigens in South India. The present study was conducted to determine the frequency of clinically significant minor blood group antigens - Rh (C, c, E and e), Kell (K, k, Kpa and Kpb), Kidd (Jka and Jkb), Duffy (Fya and Fyb) amongst regular voluntary blood donors and to form a donor database on red blood cell (RBC) antigens in the South Indian population.

Materials and methods

This prospective descriptive study was conducted in the Model Blood Bank, Department of Transfusion Medicine, Government Medical College, Thiruvananthapuram, after approval by the Institutional Research and Ethics Committee. The hospital is a major tertiary care hospital in South Kerala, with super speciality, emergency, and surgical services.

Blood samples were collected from healthy repeat voluntary blood donors between September 2018 and August 2019. Blood donors were selected from the state of Kerala (a state in South India) while donors who were from the other Indian states and foreign citizens were excluded so as to incorporate study participants with same ethnicity. The donors were selected as per the criteria laid down by the Drugs and Cosmetics Act, 1940 and Rules, 1945 and departmental Standard Operating Procedures (SOP). Written informed consent was obtained from each donor at the time of donor counselling and screening. About 2ml of blood sample was collected from each donor in sample tubes containing ethylenediaminetetraacetic acid (EDTA) anticoagulant. Phenotyping of red cell antigens were performed immediately after the blood collection. Every day, ten donor samples were typed and every tenth donor sample was included in the study.

Clinically significant blood antigens of the ABO, Rh (D, C, c, E, and e), Kell, Duffy and Kidd blood group systems were studied. The ABO and Rh(D) grouping were performed by tube technique using monoclonal antisera (Tulip Diagnostics, India). The blood units tested positive for Rh(D) antigen were labelled as Rh(D) positive. The Rh(D) negative units were further tested for the presence of weak D by column agglutination technique, using IgG monoclonal antisera anti-D (Tulip Diagnostics, Goa, India). All blood samples were phenotyped for Rh(C, c, E, e), Kell, Duffy and Kidd antigens using column agglutination technique. The phenotyping was done using the ID-Diaclon gel cards (Bio-Rad, Cressier, Switzerland). A 0.8% low-ionic strength solution was used for the preparation of red cell suspension. One positive and one negative control for each antigen were selected from the commercial cell panels (DiaCell and DiaPanel, Bio-Rad, Cressier, Switzerland). The column agglutination test for antigen phenotyping was performed as per the manufacturer's instructions. The test results thus derived using the CAT were graded from negative to 4+ reaction.

Results

Blood samples from 200 donors were typed for ABO, Rh (D, C, c, E and e), Kell, Duffy and Kidd antigens. The distribution of ABO and Rh blood groups is shown in Table-1. The most common group was found to be O (38%), followed by A (31%), B (26%), and AB (5%). Of these, 184 (92%) donors were Rh(D) positive and the remaining 16 (8%) donors were Rh(D) negative. Among the Rh antigens, the e antigen was found to be the most prevalent with a frequency of 97.8% and 100% among the Rh(D) positive and Rh(D) negative donors respectively (Table-2). The C antigen was found more frequently in Rh(D) positive donors compared to Rh(D) negative donors (90.8% vs. 6.3%, respectively). The c antigen was expressed by 100% of D negative donors, while only 40.76 % D positive donors expressed the c antigen. The E antigen was found in 19% RhD positive donors.

Table-1: *Distribution of ABO and Rh blood groups of the study population (N=200)*

Blood group	Positive Number (%)
O	76 (38)
A	62(31)
B	52(26)
AB	10(5)
D Positive	184 (92)
D Negative	16 (8)

Table-2: *Prevalence of Rh antigens among RhD positive and negative donors*

Rh Antigen	Positive among	
	RhD positive donors (n = 184) Number (%)	RhD negative donors (n = 16) Number (%)
C	167 (90.8)	1(6.3)
c	75 (40.8)	16 (100)
E	35 (19)	0
e	180 (97.8)	16 (100)

Table-3 depicts the phenotype frequencies of Rh-positive and Rh-negative groups. A total of 6 and 2 Rh phenotypes were observed among the Rh(D) positive and negative donors respectively. Among Rh positive group, R1R1 phenotype was the most frequent (47.3%), followed by the R1r (31.5%) and R1R2 (11%). Among the Rh(D) negative donors, the Rr phenotype was observed to be the most frequent (93.7%), followed by the r'r (6.3%).

Table-3: *Phenotype distribution of Rh-positive (n = 184) and Rh-negative groups (n=16)*

Phenotype of	Number (%)
Rh-positive groups (n=184)	
R1R1	87 (47.3)
R1r	58 (31.5)
R1R2	22 (11)
R2r	9 (4. 9)
R2R2	4 (2.2)
R_or	4 (2.2)
Rh-negative groups (n=16)	
Rr	15 (93.7)
r'r	1 (6.3)

Table-4 enumerates the prevalence of other minor antigens. In the Kell blood group system, the K and Kp^a antigens were absent in all donors. The k (Cellano) and Kp^b antigens were found in 100% of our donors. In the Duffy blood group system, Fy^a and Fy^b antigens were expressed by 89% and 57.5% of the donors respectively. In the Kidd blood group system, the Jk^a antigen was found in 87% of the donors, while 62% of the donors expressed the Jk^b antigen on their red cells. Detail Kell, Duffy and Kidd phenotype frequencies among the donors is illustrated in Table-5.

Table-4: *Prevalence of other red cell antigens among the study population (N=200)*

Antigens	Number (%)
K	0(0)
k (Cellano)	200 (100%)
Kp^a	0 (0)
Kp^b	200 (100)
Jk^a	174 (87)
Jk^b	124 (62)
Fy^a	178 (89)
Fy^b	115 (57.5)

Table-5: *Distribution of Kell, Duffy and Kidd phenotypes in study population (N=200).*

Phenotype	Number (%)
Kell	
K-k+	200 (100)
K+k+	0 (0)
K+k-	0 (0)
K-k-	0 (0)
Kp(a+b+)	0 (0)
Kp(a-b+)	200 (100)
Kidd	
Jk(a+b+)	98 (49)
Jk(a+b-)	76 (38)
Jk(a-b+)	26 (13)
Jk(a-b-)	0 (0)
Duffy	
Fy(a+b+)	93 (46.5)
Fy(a+b-)	85 (42.5)
Fy(a-b+)	22 (11)
Fy(a-b-)	0 (0)

Discussion

Antibodies to ABO, Rh and other clinically significant antigens are known to cause hemolytic transfusion reaction, hemolytic disease of the fetus and newborn (HDFN), or shortened survival of transfused red cells [4]. Thorough knowledge of these clinically significant antigens can help in prevention of allo-immunization in chronic multi-transfused patients. The prevalence study of such antigens is available for Caucasians and Black races [5-7], whereas only limited information is there regarding the prevalence of these antigens in Indian population.

In the present study, the ABO blood group antigen frequencies showed the prevalence as O > B > A > AB which was similar to other studies from South India [8,9] but in contrast to some Indian studies where B blood group was reported more prevalent [10,11]. It is due to the multiethnic population of our country and as a result studies in different region of India reported varied prevalence of ABO blood group. In India, the frequency of D negative antigen varies from 5% to 10% [8-12]. The frequency of Rh(D) positive in our study was 92%, whereas only 8% were Rh(D) negative. The e, D and C antigens were found to have the highest frequency. The C antigen was found to be more associated with presence of D antigen (90.8%). The R1R1 phenotype was the most frequent among Rh(D) positive donors and Rr among the Rh(D) negative donors. This is similar to other studies from India [9-14].

The K antigen was not detected in any of our donor samples. The prevalence has been shown to vary among different Indian populations. One study from India reported a low K antigen prevalence of only 0.79% [15]. The K-k+ was certainly the most common phenotype observed in our donor population.

In the Kidd blood group system, Jk(a+b+) was the most common phenotype, accounting for 49%. No Jk (a-b-) phenotype was observed. This was similar to studies by Makroo et al in which the sample size was much higher than our study [12]. Regarding the Duffy blood group system, the results observed were similar to other studies from the country. The null phenotype Fy(a-b-) was not detected, which was similar to other Indian studies but contrary to a study conducted in Western India, which demonstrated Fy(a-b-) as the most prevalent (48.7%) phenotype [16].

The finding of red cell antigen prevalence in our study is beneficial in providing appropriate immunohematology laboratory services with limited resources. A cost-effective in-house antibody screening panel of cells can be developed based on the regional antigen prevalence. The data can be used for finding the number of units to be cross matched to find a compatible unit in allosensitized multi-transfused patients. A rare donor registry can be developed and if introduced would be helpful to the entire nation in future.

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Conflict of interest

The authors declare no conflict of interest.

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