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A Preliminary Study of Clinically Significant Red Cell Antigen Phenotypes in Fayoum Blood Donors

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ABSTRACT

Background: Preliminary phenotyping of voluntary blood donors has a crucial role in transfusion practice and in ethnic genetic studies.

Objectives: As an initial step, this work was performed to study clinically significant red cell antigens in a group of Fayoum University Hospital Blood Donors. Study results will be the base for planning phenotyping strategies and cell matching policies.

Methods: The study included sixty volunteer donors fulfilling the national standards for donor selection criteria in Egypt. Donors were subjected to clinical evaluation and ABO and RhD Blood Grouping (ABO/RhD), according to the standard serologic method using column agglutination technique. Red cell antigen typing was done with monoclonal antisera using ID-card "LISS/Coombs" and ID Diamed neutral cassettes (Bio-Rad, DiaMed GmbH, Switzerland).

Results: The most frequent ABO blood group was group B (33.3%), followed by group A, O and the least frequent was group AB. However, records of 1000 donors showed that group A was the most prevalent (40.3%), followed by O (27.2%), B (22.3%) and finally AB (10.2%). The most common red cell antigens in Fayoum hospital blood bank were small e, D, small s and small c represented in 96.7%, 93.3%, 81.7% and 71.7% of our studied donors respectively.

Conclusion: Small e, D, small s, small c and K should be part of phenotyping and cross matching workup for transfusion service in Fayoum University Hospital, especially for chronic transfusion cases. The distinct distribution pattern of blood group antigens of the Fayoum donors among Egyptians requires confirmation by larger studies.

Key Words: *Blood donors – RBC antigens – Extended phenotyping – ABO Blood groups – RhD-Blood group.*

INTRODUCTION

Human blood group antigens are important determinants in transfusion medicine. A total of 352 antigens were identified; most of them are classified into 36 major systems **[1,2]**. Comparison between phenotypes among the ethnic groups and populations has established the variation of antigens in different races **[3]**. Availability of detailed information on the distribution of red cell antigen phenotypes can impact the quality of transfusion services by providing donor data, planning typing and matching cell panels and reduce the rate of allo-immunization in patients requiring repeated blood transfusions. Additionally, providing phenotyped RBCs for patients with several RBC alloantibodies is a permanent challenge to hospital blood banks that need a great deal of research to overcome **[4]**.

In this work, we performed a preliminary study of clinically significant red cell antigens in a Group of Fayoum University Hospital Blood Donors. Results will be documented and used for planning phenotyping strategies and cell matching policies. A larger study will follow to conclude phenotype distribution in Egyptians.

MATERIAL AND METHODS

The study was carried on 60 Egyptian blood donors attending Fayoum University Hospital Blood Bank including 58 males and 2 females with an age range of 18 to 24, median 31 years. The study was approved by the Fayoum Faculty of Medicine Research Ethics Committee and a written informed consent was obtained from all subjects included.

Inclusion criteria:

Donors were recruited with special emphasis on inclusion criteria of donors recommended by the national standards for donor selection

criteria in Egypt, which generally considers age, medical history, and infections.

Exclusion criteria:

- Non consenting donors.
- Donors not fulfilling the national standards for donor selection criteria in Egypt.

All donors were subjected to the following:

I- Complete history taking: For possible reasons of permanent or temporary deferral.

II- General medical examination.

III- Laboratory investigations using standard blood bank techniques in the Central Blood Bank of Fayoum University including:

1- *ABO and RhD Blood grouping:* Blood grouping (ABO/RhD) was performed, according to the standard serologic method using Column Agglutination Technique (Bio-Rad, DiaMed GmbH, Switzerland) ABO-Rh/Reverse Grouping cassettes **[5]**.

2- *Detection of the minor red blood cell groups:* Red cell antigen typing was done using monoclonal antisera by column-gel agglutination technology using ID-card "LISS/Coombs" (Bio-Rad, DiaMed GmbH, Switzerland) and ID Diamed neutral cassettes that contain gel matrix with no AHG (Bio-Rad, DiaMed GmbH, Switzerland).

The IgM antibodies are anti e, anti E, anti jka, anti K and anti c.

The IgG antibodies are anti C anti jkb, anti fya, anti fyb, anti M, anti N, anti S and anti s **[6]**.

Statistical analysis:

The statistical package (SPSS Version 12.0, SPSS Inc., Chicago, IL, USA) was used. The prevalence of phenotypes was reported using descriptive statistics. The results were expressed in percentages. Frequency of clinically significant minor blood group antigen phenotypes were statistically compared to available published frequencies using statistical Z-test.

RESULTS

Distribution of major blood groups is shown in (Table 1). The most frequent ABO blood group was Group B (33.3%), followed by Group A, O and the least frequent was group AB. Rh negative donors were 4 cases (6.7%). Retrieval of the records of 1000 blood donors revealed that blood type A was most common (40.3%) followed by Group O (27.2%), then Group B (22.3%) and lastly AB (10.2%) with similar Rh D results. The most frequent minor group antigens were e antigen, s antigen and C antigen reported in 96.7, 81.7 and 71.7% of cases respectively (Table 2). The K antigen was expressed in 10% of the population study. The most commonly occurring Kidd system phenotypes were jk (a+b–) and jk (a–b–) in 33%, followed by jk (a–b+) in 18.33% and jk (a+b+) in 15% of the donors. The most common Duffy blood group phenotype was Fy (a–b–) represented in 86.67% of the donors. The most commonly occurring MNSs blood group system phenotypes were M–N+ and S–s+ represented in 43.33% and 53.33% respectively. A comparison between our study group and results from a large national study is demonstrated in (Table 3).

Table (1): Frequency of the major blood groups among 60 blood donors from Fayoum.

Major blood group systems	Type	No.	%
ABO blood group	B	20	33.33
	A	19	31.67
	O	12	20
	AB	9	15
RhD	Positive	56	93.33
	Negative	4	6.67

Table (2): Frequency of red cell minor antigens among 60 blood donors from Fayoum.

Antigen	No. (Total=60)	%
e	58	96.7
s	49	81.7
c	43	71.7
Jka	29	48.3
N	29	48.3
S	22	36.7
C	20	33.3
Jkb	20	33.3
E	12	20.0
M	9	15.0
Fya	8	13.3
K	6	10.0
Fyb	0	0.0

Table (3): Comparison between current study Fayoum donors and donors from National Blood Transfusion Center NBTC.

Antigen	Fayoum Donors (n=60)	%	NBTC Donors (n=3219)	%	*p*-value
e	58	96.7	3152	97.92	0.251
s	49	81.7	2772	86.1	0.163
c	43	71.7	2536	78.78	0.0197
Jka	29	48.3	2700	83.88	0.0085*
N	29	48.3	1291	40.1	0.0985
S	22	36.7	1827	56.77	0.0094*
C	20	33.3	1827	56.77	0.00015*
Jkb	20	33.3	1891	58.75	0.0004*
E	12	20.0	634	19.7	0.476
M	9	15.0	2543	78.99	0.00004*
Fya	8	13.3	536	26.66	0.248
K	6	10.0	265	8.23	0.312
Fyb	0	0.0	1573	48.87	0.000014*

DISCUSSION

Knowledge of red cell antigen phenotypes in a given population is relevant for better blood transfusion services planning and management. The main goal of blood transfusion is to give donor RBCs that optimally function and survive after transfusion to ensure that the patient benefits from the transfusion. To achieve this goal, many clinical situations may require better knowledge of donor cell antigen phenotypes and population data **[7]**.

Red cell concentrates (Packed RBCs; PRBC) used for transfusions are usually cross-matched for major blood groups as ABO and Rh (D) systems. After repeated transfusions in multi-transfused patients such as thalassemic children, immunoglobulin G type of alloantibodies are produced against minor blood group systems such as Kidd, Kell, Duffy, and Rh system (E, C, e, etc) **[8]**.

The development of such antibodies can significantly complicate transfusion therapy due to the occurrence of an acute or delayed type of hemolytic transfusion reactions as they cause difficulty in finding compatible blood units and increase the risk of hemolytic disease of the newborn when such a patient becomes pregnant. Also, it can cause difficulty in stem cell transplantation and increase the chances of graft rejection in patients who are candidates for such therapy in the future **[9]**.

The aim of this study is to, preliminarily; evaluate the frequency of clinically significant red cell antigens in a group of Fayoum University Hospital Blood Donors. Results will be used to conclude an extended cross matching policy for regularly transfused patients to reduce the incidence of alloantibodies which may cause transfusion to be significantly complicated.

In this study the most frequent ABO blood group was Group B (33.3%), followed by Group A (31.67%), O (20%) and the least frequent was Group AB (15%). These results may be due to the small sample so we retrieved the records from 1000 healthy volunteer donors in Fayoum that showed that blood type A was most common (40.3%) followed by Group O (27.2%), then Group B (22.3%) and lastly AB (10.2%). A larger national study is needed for confirmation. Studying 594 donors, a comparison of the distribution of the red cell phenotypes amongst the ethnic groups in Malaysia has been performed. It was found that blood group O was the highest among the Malays and the Chinese followed by Group A, whereas in Indian donors, blood Group O and blood Group B were of equal frequencies. The frequencies of Group O were 34.5% in Malays, 38.3% in Chinese, and 36.7% in Indians. Blood Group AB was the lowest prevalence in Malaysia (7.5%), in Chinese (10.9%), and in Indian (6.7%) **[10]**.

Amongst the Rh system in our study, the highest antigen detected was small e (96.7%) followed by D (93.33%), c (71.7%), C (33.3%) and the least was E (20%). This came in close comparison to a large study carried out on the general Egyptian population by Metwally et al., **[11]** who reported frequency for e (97.92%), D (84.68%), c (78.78%), C (65.64%) and E (19.7%) with a significant difference in the C antigen only (*p*-value=0.0015).

Makroo et al., **[12]**, reported that the most common Rh antigen observed in his study was small e (98%) followed by D (93.6%), C (87%), c (58%) and the least was E antigen (20%). Also in north India Lamba et al., **[13]**, found that the small e represented 99% of the donors followed by D (93%), C (85.1%), c (62.3%) and finally E (21.5%). Another study by Kahar and Patel **[14]**, revealed the highest Rh antigen detected was small e (100%) followed by D and C (84.34 and 81.74% respectively).

Regarding the Kell system K antigen was demonstrated in only 10% of our study group which is comparable to the 8.23% reported by Metwally et al., **[11]** but higher than other population studies of 1.97% **[15]**, and 2.8% **[13]**, 3.5% **[12]**, and 6.09% **[14]** donors. It can be considered in our extended cross matching for its reported immunogenicity among multiply transfused patients in earlier studies in Fayoum population **[16]**.

The kidd system phenotypes expressed were jk (a+b–) and jk (a–b–) in 33.3% each, jk (a–b+) in 18.33% and jk (a+b+) in 15% of the studied donors. Metwally et al., reported Jka to be 83.88% and JKb to be 58.75% in the Egyptian population compared to 48.3% and 33.3% in our study (p=of 0.0004 and 0.008 respectively). Jk (a+b+) was the most common Kidd blood group phenotype previously reported representing 52.17% **[15]**, 50.4% **[13]** and 43% **[10]**.

Regarding Duffy blood group system the most frequent phenotype reported in our study was Fy (a–b–) representing 86.67% of Duffy phenotypes. This is higher than the 48.69%, reported by Kahar and Patel **[14]**. Metwally et al., reported Fya to be 26.66% and Fyb to be 48.87% compared to 13.3% and 0% in our study (p=0.248 and 0.000014 respectively). Fy (a+b–) was reported as the most dominant Duffy phenotype in several studies **[10,12,15]**.

Amongst the blood donors studied in our study, the most common MNSs system phenotype was M–N+ and S–s+ representing 43.33% and 53.33% respectively. Metwally et al., reported M, N, S, s to be 78.99%, 40.1%, 56.77% and 86.1% respectively compared to 15%, 48.3%, 36.7% and 81.7% respectively in our study with significant difference only in the M and S antigens (0.00004 and 0.0094 respectively). However, this should be cautiously interpreted on account of the small number in our series. M+N+ was reported as the most common MN phenotype in several studies **[10,14,15]** while the S–s+ was reported as the most common Ss phenotype encountered in 47.63% **[15]** and 66.96% **[14]** of cases.

In conclusion, the most common minor red cell antigens in Fayoum Hospital Blood Bank are small e, D, small s and small c represented in 96.7%, 93.3%, 81.7% and 71.7% of our studied donors respectively. These antigens should be part of phenotyping and cross matching workup for transfusion service in Fayoum University Hospital, especially for chronic transfusion cases. K antigen can be considered in extended matching policy. The distribution pattern of major and minor blood groups in Fayoum blood donors has suggested a potential unique pattern among Egyptians to be further confirmed by a larger sample.

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