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Original Research Article

Prevalence of ABO and rhesus blood groups in blood donors: a study from a tertiary care centre in south Gujarat, India

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Abstract

Background: Since it was discovered by Karl Landsteiner, the ABO blood group system is the most important blood group system in Transfusion Medicine. ABO and Rhesus (Rh) blood group antigens are hereditary characters and are useful in population genetic studies, in resolving medico-legal issues and more importantly for the immunologic safety of blood during transfusion. **Aims:** This study was carried out to determine the frequency and distribution of ABO and Rhesus (Rh) blood groups in blood donors of tertiary care hospital-attached blood bank and compare it with other data from similar studies within the India. **Materials and Methods:** This study was conducted among the blood donors of GMERS Medical College and Hospital, Valsad Gujarat State (India), who donated blood during the period from January 2017 to December 2018. ABO and Rh blood grouping was performed by forward blood grouping (cell grouping) using test tube agglutination method using antisera A, antisera B and antisera D and by reverse grouping (serum grouping) using pooled known A, B and O cells. **Results:** Out of 2971 blood donors, 2746 (92.42%) were male and 225(7.57%) were female. The blood group frequencies positions in the descending order were 'O', 'B', 'A' and 'AB' respectively. Rh positive donors were 97.54% and Rh negative were 2.45%. One group was 'Oh' (Bombay Phenotype). **Conclusions:** 'O' group is the most frequent position of ABO blood group system followed by 'B' group. Rh+ is the most frequent group than Rh- in the Rh system. Blood donations by females are very low.

Keywords: ABO, Blood bank, Rhesus, GMERS Medical College and Hospital, Valsad, Voluntary donors

Introduction

The human red blood cell (RBC) membrane is complex and contains a variety of blood group antigens, the most clinically significant being the ABO system and the Rh system [1]. The Austrian scientist Karl Landsteiner was the first to discover the ABO blood group system in the year 1900 [2]. He described A, B and O blood groups in ABO system. Later Landsteiner and Wiener defined the Rh blood group in 1941[3]. Together these two systems have proved to be the most important, for blood transfusion purposes. In 1902, Alfred Von Decastello and Adriano Sturli discovered the fourth type of blood group, AB [4]. The A subgroups have been classified as A1, A2, Aint, A3, Ax, Am, Aend, Ael, and Abantu based on the reactivity of red cells with human anti-A and anti-AB. Group A red cells which react with both anti-A and Anti-A1 are classified as A1. A1 constituted approximately 80% of entire A blood group population and group A cell which react with anti A and not agglutinated with anti-A1 are classified as A2, making up of remaining 20% [5].

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Subgroup of B is very rare and occur less frequently than subgroup of A and they are B3, Bx, Bm and Bh [6].Rh antigens are highly immunogenic. Out of 49 Rh antigens identified till now, D antigen is most significant. D negative individuals produce anti-D if they encounter the D antigen through transfusion or pregnancy and causes hemolytic transfusion reaction, or hemolytic disease of fetus and newborn. For this reason, the Rh status is routinely determined in blood donors, transfusion recipients, and in mothers-to-be [7]. Apart from their importance in blood transfusion practice, the ABO and Rh blood groups are useful in clinical studies population genetic studies, researching population migration patterns as well as resolving certain medicolegal issues, particularly of disputed paternity cases [8]. All human populations share the same blood group systems; although they differ in the frequencies of specific types. The incidence of ABO and Rh groups varies markedly in different races, ethnic groups, and socio-economic groups in different part of the world [9]. The frequencies of ABO and Rh blood groups vary from one population to another and time to time in the same region. The knowledge of distribution of ABO and Rh

blood groups at local and regional levels is helpful in the effective management of blood banks and safe blood transfusion services. Hence this study was conducted to determine the frequency of ABO and Rhesus (Rh) blood groups in a tertiary care hospital.

Material and Methods

Type of study: This retrospective study was conducted in the Blood bank, department of pathology, GMERS Medical College and Hospital, Valsad, Gujarat.

Study period: The data of blood donors during the period of two year from January 2017 to December 2018 were analysed.

Inclusion criteria: This included voluntary donors who has donated blood in the blood bank or in the outdoor voluntary blood donation camps conducted by the department. The donors were selected as per the criteria laid down by the Guideline prevailing at time. The donors were first required to fill up a donor registration form which included personal details and medical history. Those donors with haemoglobin more than 12.5 gm% were selected and screened by a medical officer. A total of 2971 donors were accepted for blood donation. After blood donation, blood group was determined by forward and reverse grouping by conventional tube method from the pilot samples of the donors following standard operative procedures of the blood bank. The forward grouping was performed using monoclonal anti A, anti B, anti H Antisera and reverse grouping performed using in house prepared A, B, O pooled cells. For Rh typing anti-D antisera was used. The blood group was confirmed only if forward and reverse groups were identical. Rh negative blood groups were confirmed by antiglobulin technique and weak D groups were considered as Rh positive. All reagents were used after subjecting it to quality control test. The donor blood group were recorded and data on frequency of ABO and Rh-D blood groups were described in percentages and compared with the similar studies.

Statistical Analysis- Microsoft office 2007 was used for the analysis. Descriptive statistics like mean and percentages were used for the analysis.

Results

The total donors studied from January 2017 to December 2018 were 2971. Table 1 shows that among total 2971 donors 2746 (92.42%) were males and 225 (7.57%) were females. Majority of the population of the blood donors came from the age group of 21 to 30 (48.19%) followed by age group 31 to 40 (26.99%).

Table-1: Age group and gender-wise distribution of blood donors.

Age (years)	Male	Female	Total (Male + Female)
18-20	287 (9.66%)	45 (1.51%)	332 (11.17%)
21-30	1272 (42.81%)	160 (5.38%)	1432 (48.19%)
31- 40	787 (26.48%)	15 (0.5%)	802 (26.99%)
41- 50	300 (10.09%)	5 (0.16%)	305 (10.26%)
51- 60	100 (3.36%)	0	100 (3.36%)
Total	**2746 (92.42%)**	**225 (7.57%)**	**2971**

Table-2: Blood group and gender-wise distribution of blood donors

ABO Blood group	Male			Female			Total Rh+	Total Rh-	Total
	Rh +	Rh -	Total	Rh +	Rh -	Total			
O	885 (29.7%)	22 (0.74)	907 (32.14%)	69 (2.32%)	1 (0.03%)	70 (2.35%)	954 (32.11%)	23 (0.77%)	977 (32.88%)
B	823 (27.7%)	23 (0.77%)	846 (30.46%)	82 (2.76%)	4 (0.13%)	86 (2.89%)	905 (30.46%)	27 (0.9%)	932 (31.36%)
A	780 (26.2%)	17 (0.57%)	797 (27.93%)	50 (1.68%)	0	50 (1.68%)	830 (27.93%)	17 (0.57%)	847 (28.5%)
AB	190 (6.39%)	5 (0.16%)	195 (6.96%)	17 (0.57%)	2 (0.06%)	19 (0.63%)	207 (6.69%)	7 (0.23%)	214 (7.2%)
Oh Bombay phenotype	1 (0.03%)		1 (0.03%)				1 (0.03%)		1 (0.03%)
	2679 (90.17%)	67 (2.25%)	2746 (92.42%)	218 (7.33%)	7 (0.23%)	225 (7.57%)	2897 (97.54%)	74 (2.49%)	2971

Table-3: Comparison study on frequency of ABO and Rh phenotype (%) at different geographical areas in India

Region	Author	Study size (n)	Blood group frequency (%)					
			A	B	O	AB	Rh D positive	Rh D negative
North India								
North zone	Agrawal A et al	2042	24.54	34.47	29.43	11.55	94.8	5.19
Lucknow	Chandra T et al	140320	21.38	39.92	29.27	9.43	95.71	4.29
	Nanu and Thapliyal	6334	24.7	37.5	32.5	5.3	95.37	4.63
Punjab	Sindhu S et al	1150	21.91	37.57	31.22	9.3	97.3	2.7
West India								
West zone	Agrawal A et al	2220	23.69	32.74	36.75	6.8	92.97	7.02
Rajasthan	Behra R et al	83631	22.2	36.4	31.7	9.4	91.75	8.25
Present study		2971	28.5	31.36	32.88	7.2	97.54	2.49
Central India								
Centre zone	Agrawal A et al	2021	23.1	26.57	43.24	7.07	96.23	3.72
Indore	Gupta NK et al	17080	24.15	35.25	31.5	9.1	95.43	4.57
East India								
East zone	Agrawal A et al	1595	21.88	33.85	37.55	6.7	95.23	4.76
Durgapur	Nag I et al	3850	23.9	33.6	34.8	7.7	94.7	5.3
South India								
South zone	Agrawal A et al	1808	20.68	33.07	38.99	6.25	93.91	6.08
Karnataka	Periyavan S et al	36964	23.85	29.95	39.81	6.37	94.21	5.79
South India	Das et al	150536	18.85	32.69	38.75	5.27	94.53	5.47

Table 2 shows the distribution of blood group systems. The commonest ABO blood group was O (32.88%) followed by B (31.36%), A (28.5%) and AB (7.2%) respectively. The distribution of ABO Rh positive blood groups were as follows, blood group O positive 32.11%, B positive 30.46%, A positive 27.93%, and AB positive 6.69%, There was one Bombay blood group detected during the study period. The distribution of Rhesus (Rh) D factor were as follows, 2897 (97.54%) Rh D positive and 74(2.49%) Rh D negative. Among Rh D negative blood donors, B negative (0.9 %) was most common followed by O negative (0.77%), A negative (0.57%), and AB negative (0.23%).

Discussion

Almost all the previous studies within India except the study in Tripura [10] have found that numbers of male blood donors are much more comparing to the female donor which is in agreement with this present study.

The present study showed large number of male donors (92.42%) compared to female donors (7.57%) which is comparable with other studies within India [11-13]. This is because of the fact that in developing country like India, because of social taboo, cultural habits, lack of motivation and fear of blood donation, female donors are very less. On Pre-donation screening, a large number of menstruating females found to be anaemic with low body weight and hence declared unfit for blood donation.

Hence, general health of females needs to be improved by good nutritional diet and iron supplements. Females need to be motivated and aware of advantages of Blood Donation, removing fears and myths from their mind. In Tripura because of better implementation of primary health care system less numbers of women are suffering from nutritional anaemia than many other parts of India and also because of continuous motivation less numbers of women are afraid of blood donation. As a result, more numbers of women are participating in donation of blood [10].

The main work force of any of the society is of age group 18-40. So, this is the most common age group encountered donating blood. This is comparable with other studies [12,14]. The least donors were of age group 51 – 60 and above because many of the people of this age group suffer from hypertension, diabetes mellitus, low haemoglobin and ischemic heart diseases and hence abstain from donating blood or are considered unfit during pre-donation counselling

The phenotype and genotype frequencies of ABO and Rh groups vary widely across different races and geographical areas of the world. There were few studies have been done across the India to find out this variation. As shown in Table 3, there are variations in ABO blood group frequency across the India [15-23].

According to the studies done in Northern India and Western India, B group was having highest prevalence (34-40 %) followed by O, A and AB blood group.[15-19] The present study showed O group was having highest prevalence followed by B, A and AB blood group which is similar finding with the multi-centric study done by Agrawal A et al which concluded that O blood group was having highest prevalence in the western India [15].

Studies done in the Eastern India and Southern India showed that blood group O has highest prevalence (34-40 %) followed by B, A & AB blood group [21-23]. The present study also showed similar findings with all studies.

The study done by Agrawal A et al showed O blood group with highest frequency while the study done by Gupta NK et al showed B as the leading blood group for the Central India [15-20].

In the present study, 97.54 % of blood donor population showed Rh positivity for D antigen while 2.49% showed Rh D negativity. The Rh D positive blood group was found in the range of 91 % to 97 % across the India in different studies [15-23]. The present study correlate with these findings of all studies. Study conducted in Bangalore shows only 2 (0.005%) donors out of 36,964 with Bombay blood group (Oh) [24]. While Study conducted by Sanagapati PR in hydrabad shows 1 (0.05%) donor out of 1740 with a Bombay blood group [25]. In present study, it was found 1 (0.03%) donor with a Bombay blood group.

Conclusions

This study concludes that "O" Rh +ve (32.11%) blood group is the most common blood group among the voluntary donors who has donated blood in the blood bank or in the outdoor voluntary blood donation camps conducted by the department. This is closely followed by "B" Rh +ve (30.46%) > "A" Rh +ve (27.93%) > "AB" Rh +ve (6.69%) > "B" Rh −ve (0.9%) > "O" Rh −ve (0.775%) > "A" Rh −ve (0.57%) > "AB" Rh −ve (0.23%) blood groups, respectively Regarding Rh blood group system, Rh +ve donors were 97.54% and Rh −ve were 2.49%. Blood donation by the females was very low (7.57%) compared to males (92.42%) and it needs to be increased by improving health status of females and awareness about blood donation. Every individual should be ABO grouped at birth since the antigens are naturally occurring. Groups of individuals indicated on national identity cards, driving licenses, and school/office identity cards will be of tremendous use in case of acute haemorrhage or anaemia in children or in cases of maternal need at time of delivery when urgent transfusion is required. It is necessary to conduct similar well-designed studies in other states of India to determine the blood group frequencies in them.

What the study adds to the existing knowledge?

The data generated in the present study and knowledge of blood group distribution is also important for other studies of different geographical regions of India which will be useful to health planners while making efforts to face the future health challenges in the particular region, clinical studies, for reliable geographical information, and for forensic studies in the population. Besides, these studies will help a reducing the maternal mortality rate. The knowledge of the distribution of blood group is very important for blood banks and transfusion services which play an important role in the patient's health care. This study will also throw light on the reasons of deficiency of a particular group in a particular area so that deficient group donors may be encouraged to donate more frequently. Any discrepancy between the supply and demand of a particular group will be taken care of and deficient blood group donors will be encouraged to donate more frequently, i.e., in our case "A" Rh +ve persons are required to donate more frequently than other blood groups to meet the demands.

Author's contribution

Dr. Sunita Mistry: Concept, study design, manuscript preparation
Dr. Kamini Patel: Statistical analysis, manuscript preparation
Dr. Kamlesh Shah: Manuscript preparation

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