

Research Article

ABO Rh (D) blood group distribution among whole blood donors at two different setups of tertiary care hospitals in North India

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ABSTRACT

Background: The antigens for ABO blood group system are of paramount significance in transfusion medicine as they are the most immunogenic of all the blood group antigens known, followed closely by D antigen of rhesus blood group system. The ABO blood group system has been used in resolving many medico-legal issues related to paternity, by investigators in forensic science or in population studies by anthropologists. ABO-Rh D blood grouping is the commonest test done in blood banking and forms the mainstay of pretransfusion testing and any ABO-incompatible blood transfusion can be associated with acute intravascular hemolysis, renal failure, and even death.

Methods: A retrospective study for ABO RhD blood group distribution was carried out on whole blood donors who successfully donated at two different blood centres, hospital I at New Delhi for a period of one year from July 1, 2011 to June 30, 2012 and hospital II at Dehradun from January 1, 2013 to 31 December, 2015.

Results: It was observed that the frequencies (%) of blood group A, B, O and AB for hospital I and II were A =22.6, 23.4; B=37.8, 35.6; O=29.5, 29.5 and AB=10.1, 11.4 respectively. And at both the centers, Rh D positivity was observed as 94.5% and Rh D negativity as 5.5%.

Conclusions: It is advisable to determine the distribution of ABO and Rh D phenotypes among blood donors in each blood centre so as to stock adequate number of respective blood group units and provide timely and adequate blood supply to the needy recipient even in the wee hours.

Keywords: ABO blood group system, RhD blood group, Whole blood donors

INTRODUCTION

ABO, the first human blood group system to be discovered, has marked the beginning of the concept of ipseity and since then it remains the most significant in Transfusion Medicine with respect to blood transfusion, hematopoietic stem cell transplantation, and solid organ transplantation. This is because of the fact that the individuals predictably have naturally occurring antibodies, directed against missing A and B antigens. These antigens are found on red cells, platelets, many

circulating proteins in blood and on many tissues like those of kidney, heart, pancreas, bowel and lung. ABH antigens are not fully developed at birth and it is not until 2-4 years of age that an individual gets fully developed antigens and after which they remain constant throughout life.¹

Transfusion of ABO-incompatible blood can be associated with acute intravascular hemolysis, renal failure, and even death. Likewise, transplantation of ABO-incompatible organs is associated with acute

humoral rejection. The ABO system consists of four major ABO phenotypes: A, B, O, and AB which are determined by the presence or absence of two antigens (A and B) on red cells. An inverse reciprocal relationship exists between the presence of A and/or B antigens on red cells and the presence of anti-A, anti-B, or both, in sera.²

Rhesus (Rh) is another important blood group system after ABO in transfusion medicine and among more than 55 Rh antigens known, D antigen is the most potent one. It is the presence or absence of the D antigen that makes an individual RhD positive and RhD negative respectively.

Unlike ABO blood group system, the anti-D so formed is not naturally occurring and is always caused by red cell immunization from pregnancy or transfusion and usually persists for many years. Most RhD antibodies should be considered as having the potential to cause clinically significant haemolytic disease of fetus and newborn (HDFN) and transfusion reactions.³

ABO and RhD blood group antigens are those hereditary characters which are proven to be beneficial in compatibility test in blood transfusion practice, in population genetic studies, resolving medico-legal issues and paternity disputes.⁴

ABO and RhD testing is the most frequently performed test in blood banking and forms the mainstay of pretransfusion testing for incompatibility between a donor and recipient.

Therefore, it is prudent to carry out a study on the distribution of ABO and Rh phenotypes in each blood centre so as to stock adequate number of respective blood group units and provide timely and adequate blood supply to the needy recipient.

We carried out this study to assess the distribution of ABO and Rh D blood groups at two hospitals at two different cities approximately 250 kilometres apart in Northern parts of India. The hospital centres were chosen purposely as majority of the patient population visiting the hospital at Dehradun is migratory and moves between Delhi and Dehradun. This led us to hypothesize the fact that the distribution of ABO blood groups among donor population would be the same at both the centres.

METHODS

The present study on ABO RhD blood group distribution was carried out on whole blood donors who successfully donated for a period of one year from July 1, 2011 to June 30, 2012 with hospital I at New Delhi and from January 1, 2013 to 31 December, 2015 with hospital II at Dehradun, capital city of Uttarakhand state.

The blood collections were taken from the replacement and voluntary donors at in-house blood donation area (BDA) in blood bank and voluntary donors at outdoor blood donation camp (BDC) from hospital I while only in-house voluntary and replacement donations were done at blood bank at hospital II.

At hospital I, after blood donation, blood group was determined by forward blood grouping (cell grouping) and reverse blood grouping (serum grouping) done by microplate heam-agglutination method using commercially available standard blood grouping antisera

(A, B, AB and D) and Pooled human known A, B and O cells prepared daily at the blood bank.

Final blood group is designated to a donor only if both forward group (cell group) and reverse group (serum group) are identical by fully automated equipment (Ortho Innova, AUTOVUE, Ortho clinical diagnostics limited, USA). Rh D negative blood groups were confirmed by indirect antiglobulin technique (IAT). The donor blood group data was recorded on especially formatted log books.

At hospital II, donor blood grouping is routinely performed (using ABD-Reverse Diluent cassettes) on fully automated equipment (Ortho Innova, AUTOVUE, Ortho clinical diagnostics limited, USA) as per standard operating procedure.

RESULTS

The frequencies of ABO and RhD blood group phenotypes were assessed for donor population of 15446 at hospital I and of 6350 donors at hospital II. At hospital I, of total donors, 15140 (98.01%) were males and 306 (1.98%) were female donors (Table 1). A total of 12492 (80.88%) donors donated in blood donation area in blood bank, of which 11782 (94.3%) were Rh-positive and Rh-negative were 710 (5.68%).

A total of 2954 (19.12%) donors successfully donated in outside blood donation camps where Rh-positive donors were 2810 (95.12%) and Rh-negative were 144 (4.87%) at hospital I (Table 2). At hospital II, of 6350 donors, 6172 (97.2%) were males and 178 (2.8%) were female donors reflecting there were higher number of female blood donors at hospital II than hospital I (1.98%).

Of total, 94.5% (n=6004) were Rh D positive and 5.45% (n= 346) were Rh D negative donors (Table 3 and 4). Among ABO blood groups, it was observed that the frequencies of blood group A, B, O and AB for hospital I and II were A =22.6,23.4; B=37.8,35.6; O=29.5, 29.5 and AB=10.1,11.4% respectively (Table 2 and 4).

Table 1: Gender wise distribution of ABO and Rh phenotypes at hospital I.

Blood group	Male	Male	Female	Female	Grand total
	Rh positive	Rh negative	Rh positive	Rh negative	
A	3192	229	61	9	3491 (22.6%)
B	5445	286	105	4	5840 (37.8%)
O	4219	235	92	9	4555 (29.5%)
AB	1454	80	24	2	1560 (10.1%)
Total	14310 (92.64%)	830 (5.37%)	282 (1.82%)	24 (0.16%)	15446 (100%)

Table 2: Distribution of ABO and Rh phenotypes at hospital I.

Blood group	BDA*	BDC [#]	Total
Rh D positive			
A	2645	608	3253 (21.06%)
B	4538	1012	5550 (35.93%)
O	3423	888	4311 (27.91%)
AB	1176	302	1478 (9.56%)
Total			14592 (94.47%)
Rh D negative			
A	198	40	238 (1.54%)
B	244	46	290 (1.88%)
O	200	44	244 (1.58%)
AB	68	14	82 (0.53%)
Total			854 (5.53%)
Grand total	12492 (80.88%)	2954 (19.12%)	15446 (100%)

*BDA – Blood donation area; # BDC – Blood donation camp.

Table 3: Gender wise distribution of ABO and Rh phenotypes at hospital II.

Blood group	Male	Female	Male	Female	Grand total
	Rh positive	Rh positive	Rh negative	Rh negative	
A	1364	37	85	2	1488 (23.4%)
B	2088	56	110	6	2260 (35.6%)
O	1718	46	109	2	1875 (29.5%)
AB	667	28	31	1	727 (11.4%)
Total	5837 (91.92%)	167 (2.62%)	335 (5.27%)	11 (0.17%)	6350 (100%)

Table 4: Distribution of ABO and Rh phenotypes at hospital II.

Blood group	Rh D positive	Rh D negative	Grand total
A	1401 (22.06%)	87 (1.37%)	1488 (23.4%)
B	2144 (33.8%)	116 (1.82%)	2260 (35.6%)
O	1764 (27.8%)	111 (1.75%)	1875 (29.5%)
AB	695 (10.9%)	32 (0.5%)	727 (11.4%)
Total	6004 (94.55%)	346 (5.45%)	6350 (100%)

DISCUSSION

Currently 36 human blood group system genes have been identified and sequenced and all the polymorphisms are now known. Each blood group system represents either a single gene or a cluster of closely linked homologous genes. The resultant polymorphism remains important in

population genetic studies, estimating the availability of compatible blood, evaluating the probability of haemolytic disease in the new born, resolving disputes in paternity/maternity and for forensic purposes.

The ABO blood group distribution varies ethnically, regionally and from one population to other.⁵ The present study showed that the donor populations have 'B' blood

group as the commonest followed by O, A and AB as the least at both the centres. Among Rhesus blood group

system, Rh positive donors were 94.5% and negative were 5.5% at both the places.

Table 5: Glance at the ABO and Rh phenotype frequencies (%) among blood donors at various geographical regions in India and abroad.

STUDY	A	B	O	AB	RhDpos	RhDneg
Northern India and neighbouring countries						
Present Study Location I (Delhi)	22.6	37.8	29.5	10.1	94.47	5.53
Present Study Location II (Dehradun, UK)	23.4	35.6	29.5	11.4	94.55	5.45
New Delhi ⁶	21.24	39.69	28.51	10.56	91.16	8.84
Delhi ⁷	22.3	39.2	29.6	8.9	93.8	6.2
Kumaon, Uttarakhand ⁸	28.7	32.07	28.7	10.05	94.4	5.51
Poonch, J&K ⁹	21.40	36.60	35.00	7.00	89.90	10.50
Pakistan ¹⁰	27.92	32.40	29.10	10.58	93.0	7.0
Nepal ¹¹	34	29	32.5	4	96.7	3.3
Western India						
Western Ahmedabad ¹²	21.94	39.40	30.79	7.86	95.05	4.95
Maharashtra, Amravati ¹³	27.02	33.06	31.04	8.33	95.73	4.27
Eastern India						
Guwahati, Assam ¹⁴	24.5	30.2	36.8	8.41	97.0	3.0
Durgapur ¹⁵	23.9	33.6	34.8	7.70	94.70	5.30
Maram tribe, Manipur ¹⁶	20	27.3	35	17.7	65	35
Tripura ¹⁷	28.68	34.7	25.93	10.61	-	-
Southern India						
Bangalore ¹⁸	23.85	29.95	39.82	6.37	94.20	5.79
Belgavi, Karnataka ¹⁹	22.19	26.99	34.92	15.88	97.87	2.13
Malnad, Karnataka ²⁰	24.27	29.43	39.17	7.13	94.93	5.07
Tirupati ²¹	20	32.2	41.7	6.1	92.8	7.2
Vellore ²²	18.85	39.40	38.75	7.86	94.5	5.47
Puducherry ²³	39.50	20.50	34.00	6.50	93.50	6.50
Outside India						
Britain ²⁴	42	8	47.0	3	83	17
Nigeria ²⁵	21.6	21.4	54.2	2.8	95.2	4.8
USA ²⁶	41.0	9.0	46.0	4.0	85.0	15.0
Bangladesh ²⁷	26.6	23.2	40.6	9.6	96.8	3.2

Among other centres in Northern India and neighbouring country Pakistan, the trend of ABO frequency was same as B>O>A>AB blood groups but the frequency of A blood group among Kumaon population in Uttarakhand (28.7%) and neighbouring Nepal (34%) was reported to be higher as compared to other parts of North.⁶⁻¹¹ Similar observations of 'B' blood group being the commonest were made from Western states.^{12,13}

The distribution of ABO and RhD blood groups when compared to the studies done at eastern or southern parts of the country and few other parts of the world showed contrasting observations wherein blood group O is the most prevalent.¹⁴⁻²⁷ All over the world, the frequency of Rh positivity is observed as between 89-95% with the exception being Britain and United States of America where frequencies of Rh positive and negative are 83-

85% and 15-17% respectively. This reflects clearly that ABO blood group antigens appear to have been important throughout our evolution because the frequencies of different ABO blood types vary among different populations, suggesting that a particular blood type conferred a selection advantage. It is known that there is no risk of any disease due to lack of expression of ABO blood group antigens, but there is a susceptibility of a number of diseases linked with an individual's ABO phenotype.⁴

ABO blood group system has got significant association with several diseases like hypertension, migraine, gastric or pancreatic carcinoma, diabetes mellitus and von Willibrand disease as reported in literature time and again.^{28,29} Gastric cancer appears to be more common in group A phenotype individuals, whereas gastric and

duodenal ulcers occur more often in group O phenotype individuals.^{30,31} Another observation is that individuals with blood type O tend to have lower levels of the von Willebrand Factor (vWF), which is a protein involved in blood clotting.³²

CONCLUSION

There is a great benefit of conducting observational studies on ABO Rh frequencies at each centre as it gives insight to take preventive measures for the diseases which are associated with different blood groups and prepare data for the health professionals to envisage future challenges related to natural or manmade disasters. ABO and Rh blood group distribution among donor population helps in efficient management of transfusion services by making appropriate arrangement of the respective blood groups round the clock and meet the ever increasing demand of recipient population and hence preventing mortalities due to blood loss. The practice of blood grouping each one at birth must be made mandatory and same should be documented in birth card or maintained as an identity card throughout life which can be of huge help during haemorrhage in any road/air/rail/terror mishap.

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