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Original Research Article

Prevalence and distribution of ABO and Rh-D blood groups in the Barpeta district of lower Assam in north-east India: Importance in regional blood transfusion service

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Abstract: The knowledge of the distribution of ABO and Rh-D blood groups is essential for effective management of blood bank inventory by estimating the availability of compatible blood and also evaluating the probability of hemolytic disease in the new born. Among a total 35 blood groups systems and over 600 different blood group antigens discovered so far ABO and Rhesus are the most important blood group system. Importance of Rh-blood group system is due to immunogenicity, polymorphism and complexity of its antigens. ABO and Rh-D grouping were done in 40,915 samples from blood donors, transfusion recipients, antenatal cases and other routine medical cases in the Blood Bank, Fakhruddin Ali Ahmed Medical College & Hospital, Barpeta, Assam. Data on the frequency of ABO and Rh-D blood groups were reported in simple numbers and percentages. Among the various ABO and Rh-D blood groups, "O" (37.86%) group is the most common followed by "B" (32.96%), "A" (23.4%) and "AB" (5.78%) with a predominance's of Rh positivity (96.28%). The remaining 3.72% was Rh-D negative. Study of distribution of blood group is not only important for effective management of blood bank and transfusion services but it is also essential for geographical information, genetic studies, clinical medicine and forensic medicine in addition to compatibility testing done before transfusion.

Keywords: Blood group, ABO, Rh-D, Blood transfusion, Antigen, Blood donor.

Introduction

Blood group antigens are integral parts of the red blood cell membrane [1, 2]. Almost 35 blood group system[3] and over 600 different blood group antigens[4] are discovered so far, of which ABO and Rh-blood group system are most important blood group systems in blood transfusion services. Karl Landsteiner in 1900 and Von DeCastello in 1902 discovered ABO and "AB" blood group system respectively and then classified ABO blood group system into "A", "B", "AB" and "O" blood group based on the presence or absence of "A" and "B" antigens on red cells[5, 6]. The ABO antibodies can cause intravascular hemolysis, renal failure and death in ABO mismatch transfusion and they are mainly IgM in nature. The presence or absence of antigens on red cells can be determined by serological testing with antisera which represents the phenotype[7]. In case of "reverse grouping" known red cells are used to detect anti A and anti B in the serum. ABO and Rh-gene phenotype vary widely across races and geographical boundaries[8, 9, 10] despite the fact that the antigens involved are stable throughout life. The knowledge of the distribution of ABO and Rh-D blood groups is essential for effective management of blood bank inventory by estimating the availability of compatible blood and also evaluating the probability of hemolytic disease in the new born.

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Different blood groups have been shown to be particularly associated with different diseases as well[11,12]. Rh-system is considered as second most important blood group system due to hemolytic disease of new born and its importance in multiple transfused cases developing Rh-antibodies in Rh-negative individual[13]. Importance of Rh-blood group system is due to immunogenicity, polymorphism and complexity of its antigens. Apart from their importance in blood transfusion services, the ABO and Rh-D blood group antigens are useful in population genetic studies, researching population migration patterns as well as resolving certain medico-legal issues particularly disputes in paternity/maternity and for forensic purpose[14]. Hence, it is essential to have information on the distribution of these blood groups in any population[15].

No study has been done investigating the ABO and Rh-D typing frequency in any population in Barpeta district of Lower Assam. The population structure of Barpeta district with over 16 lacs people, mainly comprises of Assamese, Bengali & Bodos. The Fakhruddin Ali Ahmed Medical College & Hospital (FAAMCH), Barpeta occupies an important place in the health sector of Lower Assam including foot hills of Bhutan. This blood

bank receives blood samples for grouping from almost all population of Barpeta district it as being blood donors, blood recipients, patients admitted and attended for treatment, routine antenatal care as well as for routine medical examinations. Thus the FAAMCH, Barpeta, Blood Bank does and keeps records of blood groups of these all kind of population. Hence, we did a retrospective analysis of records of ABO grouping and Rh-D typing of the blood donors, transfusion recipients and patients attending antenatal care or some other medical interventions over a period of 3 years from January 2011 to December 2013. This study seeks to provide data on ABO and Rh-D groups distribution in the Barpeta district in Lower Assam.

Material and Methods

This was a retrospective study conducted over a period of 3 years (Jan, 2011 to Dec, 2013) on records of blood grouping of blood donors, transfusion recipients and patients attending antenatal care or some other medical interventions in the Blood Bank, Department of Pathology, Fakhruddin Ali Ahmed Medical College & Hospital, Barpeta, Assam, India.

Venous blood was collected in EDTA and plain clean vacutainer tube and allowed to clot naturally at room temperature. The ABO blood grouping and Rhesus typing were determined by tube method (Forward and Reverse grouping). Forward grouping was done using monoclonal antisera-anti A, anti B, anti AB and anti D (Eryclone, Tulip Diagnostic Ltd., Goa, India). Results of forward grouping were confirmed by reverse grouping using known pooled A and B red cells. Data on the frequency of ABO and Rh-D blood groups were reported in simple numbers and percentage.

Table I: Different Sources of Samples for ABO and Rh-D Grouping

Source of Blood Samples	Numbers	Percentage
Blood Donors	11,100	27.13%
Transfusion recipients	9,655	23.60%
Antenatal Cases	16,380	40.03%
Routine Medical Case	3,780	9.24%
Total	40,915	100%

Table II: The Frequency of ABO and Rh-D Phenotypes in the Population Sample Studied

Blood Samples	ABO Blood Group Phenotype				Rh-D Phenotype	
Number	Group-A	Group-B	Group-AB	Group-O	Rh-D positive	Rh-D negative
	9,574	13,485	2,366	15,490	39,393	1,522
Percentage	23.4%	32.96%	5.78%	37.86%	96.28%	3.72%

Table III: The Frequency of Rh-D Phenotypes in the various ABO Blood Groups of the Different Population Sample

Blood Samples	A-Pos	A-Neg	B-Pos	B-Neg	AB-Pos	AB-Neg	O-Pos	O-Neg	Total
Numbers	9,194	380	13,084	401	2,276	90	14,840	650	40,915
Percentage	22.47%	0.93%	31.98%	0.98%	5.56%	0.22%	36.27%	1.59%	100%

Table IV: The Frequency of Rh-D amongst A, B, AB and O Groups

Blood Group	Rh-Positive	Rh-Negative	Total
A	9,194 (22.47%	380 (0.93%)	9,574 (23.4%)
B	13,084 (31.98%)	401 (0.98%)	13,485 (32.96%)
AB	2,276 (5.56%)	90 (0.22%)	2,366 (5.78%)
O	14,840 (36.27%)	650 (1.59%)	15,490 (37.86%)

Table V: Comparison of distribution (%) of ABO and Rh blood groups in different countries of the World and also India.

Place of Study:

(A)	Outside India	A	B	O	AB	Rh+ve	Rh-ve
(i)	USA	41.00	9.00	46.00	4.00	85.00	15.00
(ii)	Britain	41.70	8.60	46.70	3.00	83.00	17.00
(iii)	Australia	38.00	10.00	49.00	3.00	NA	NA
(iv)	Whites	41.00	10.00	45.00	04.00	NA	NA
(v)	Blacks	28.00	19.00	49.00	04.00	NA	NA
(vi)	Saudi Arabia	25.00	19.00	52.00	04.00	93.00	7.00
(vii)	Bangladesh	26.6	23.2	40.6	9.6	96.8	3.2
(viii)	Pakistan	23.8	38.00	28.2	10.00	89.1	10.9
(ix)	Nepal	34.00	29.00	33.00	4.00	96.7	3.3
(x)	Nigeria	24.43	23.88	48.94	2.75	95.67	4.33
(xi)	Kenya	26.20	22.00	47.48	4.32	96.10	3.90
(xii)	Mexicans	28.00	13.00	56.00	03.00	NA	NA

(B) Within India:

Place of Study	A	B	AB	O	Rh+ve	Rh-ve
Within India						
Southern Part of India						
Bangalore[19]	23.85	29.95	6.37	39.82	94.2	5.8
Vellore[20]	21.86	32.69	6.70	38.75	94.5	5.5
Devanagere[21]	26.15	29.85	7.24	31.76	94.8	5.2
Shimoga-Malnad[22]	24.27	29.43	7.13	39.17	94.93	5.07
Eastern Part of India						
Durgapur (Steel City)[23]	23.90	33.60	7.70	34.80	94.70	5.30
Western Part of India	23.30	35.50	8.80	32.50	94.20	5.80
Eastern Ahmedabad[24]						
Western Ahmedabad[25]	21.94	39.40	7.86	30.79	95.05	4.95
Surat[26]	24.10	34.89	8.69	32.32	94.18	5.82
Central Part of India	24.15	35.25	9.10	31.50	95.43	4.57
Indore[27]						
Northern Part of ndia						
Lucknow[28]	21.73	39.84	9.33	29.10	95.71	4.29
Punjab[29]	21.91	37.56	9.3	31.21	97.3	2.7

Results

During the period of 3 years between 1st January 2011 to 31st December 2013, a total of 40,915 blood samples were tested for ABO and Rh-D grouping at FAAMCH, Barpeta, Assam. Table-I shows that out of 40,915 samples 11,100 (27.13%) were from blood donors, 9,655 (23.60%) were from transfusion recipients, 16,380 (40.03%) were from antenatal cases and 3,780 (9.24%) were from routine medical samplings. Table-II shows the distribution of various ABO and Rh-D Phenotypes among the blood sample studied. The frequency of "O" group phenotype was most common (37.86%) followed by "B" (32.96%), "A" (23.4%) and "AB" group (5.78%). Rh-D antigen was detected in 39393 (96.28%) samples while Rh-D negative phenotype was found in 1522 (3.72%) samples in the total sample size of 40915. Table-III shows the frequency of Rh-D phenotypes among the sample studied in relation to ABO blood group. Rh-D positivity to blood group "O", "A", "B" and "AB" were found in the study as 36.27%, 22.47%, 31.98% and 5.56% respectively. Rh-D negativity to the blood group "O", "A", "B" and "AB" were found in the study as 1.59%, 0.93%, 0.98% and 0.22% respectively. Table-IV shows a frequency of Rh-D phenotype among the sample studied with respect to individual blood group. The Rh-D positivity and negativity of total 15490 group "O" samples (100%) showed 36.27% and 1.59% respectively, whereas in total 2366 (100%) "AB" group it was 5.56% and 0.22% respectively. Out of total 9574 group "A" sample 22.47% showed Rh-positivity and 0.93% as Rh-negativity. For group "B" sample (total 13485 samples), 31.98% showed Rh-positivity and 0.98% Rh-negativity.

Discussion

Different distribution of blood groups in population within the country is due to lot of diversity in our country based on race, religion and creed. A racial difference in the distribution of blood groups has been noted by some researchers [16, 17]. Few studies on the prevalence of ABO and Rh-blood groups have been carried out in the Indian population and majority of these studies are limited to individual communities or to a particular

region of the country[18]. No such study has yet been reported from Barpeta district of Lower Assam.

In the present study maximum number of cases were reported from obstetric and Gynecology department (antenatal cases) (40.03%) followed by blood donors at blood bank (27.13%), recipient of blood transfusion (23.60%) and routine medical cases from other department (9.24%). This study revealed that blood group "O" was the most prevalent at 37.86% followed by "B" (32.96%), "A" (23.4%) and "AB" (5.78%). This observation is in accordance with previous studies by different authors from other parts of India particularly Southern[19-22], Eastern[23] and Central India[27]. But it was observed that in Northern[28,29] and Western[24,25,26] India "B" is the commonest blood group. In USA[30] and Britain blood group "O" is the most common (46% and 46.70% respectively) followed by "A", "B" and "AB". Similarly in Saudi Arabia[31] (52%), Iran[32] (41.16%), Egypt[33] and Australia[34] (49%) the commonest blood group was "O". In contrast, commonest blood group in Nepal (Pramanik *et al.,*) [35] and Russia[36] is "A" blood group. In Pakistan (Hammed *et al.,*) [37] and Africa[38] "B" blood group is common.

Study done by Nag *et al.,*[23], Anjali *et al.,*[39], Periyavan *et al.,*[19], Enosolease and Bazuaye *et al.,* [40], Das *et al.,* [20], Mwangi *et al.,* [41] also showed that "O" blood group was most common. Mordant *et al.,* [42] have shown that the frequency of ABO/Rh blood group is valid only for the specific region or the specific population group from where the data were derived. Barpeta District is a part of lower Assam in North East India. FAAMCH, Barpeta is the only Medical College in lower Assam and has a large catchment area including neighboring district and populations living in foot hills of Bhutan. As the blood donors that donate blood, transfusion recipient, antenatal cases and other medical cases in this tertiary level hospital belong mostly to Lower Assam and so represent the population of Lower Assam. Hence, the data revealed in this study fairly reflects the frequency of distribution of ABO and Rh-D blood group antigen among the population of Lower Assam.

The present study showed that the frequency of Rhesus "D" antigen is 96.28% and Rh-D negative is 3.72%. This finding of Rh-D antigen is in agreement with the results of other studies in India, i.e. - Sharma *et al.,* (91.6%)[43] from Central India, Thakral *et al.,* (93.39%)[44] from North India and Gundrajukuppam *et al.,* [45] from South India. Our study showed Rh-negativity of 3.72% as compared to other studies in countries like USA (15%), Britain (17%) and Pakistan (10.9%). So, the expected frequency of Rh-isoimmunization would be lower in our population than that encountered in those countries. Geographical prevalence of Rh-D antigen varies in different parts of the World with highest rate seen in the Japanese and Burmese population (99-100%) and lower rate in European population (85%) and particularly least rate in South France and Northern Spain (60-80%)[46].

Conclusion

We established that among the various ABO and Rh-D blood groups, "O" (37.86%) group is the most common followed by "B" (32.96%), "A" (23.4%) and "AB" (5.78%) with a predominance's of Rh positivity (96.28%). Study of distribution of blood group is not only important for effective management of blood bank and transfusion services but it is also essential for geographical information, genetic studies, clinical medicine and forensic medicine in addition to compatibility testing done before transfusion.

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