

# Study of ABO Blood Groups and Subgroups A<sub>1</sub>, A<sub>2</sub>, A<sub>1</sub>B and A<sub>2</sub>B in Blood Donors and Recipients

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## ABSTRACT

**Background:** Blood transfusion in modern era is possible only due to the knowledge of exact blood groups and sub blood groups. Over 700 erythrocyte antigens have been reported and are organized into 35 blood group systems by International Society of Blood Transfusion. These antigens may be proteins, glycoproteins or glycolipids and are controlled by single or more gene locus. Some antigens are specific to red cells; whereas, others are found on other cells throughout the body. The ABO blood group was the first human blood group to be discovered by Landsteiner in 1900 and it served the beginning of Blood Banking and Transfusion Medicine. Numerous mutations are found in A, B and O genes, but the most common mutation is A<sub>2</sub>. The A<sub>2</sub> gene has two nucleotides different from the A<sub>1</sub> gene which results in diminished enzymatic activity and consequently, weakened antigen expression. Distinction between A<sub>1</sub> & A<sub>2</sub> made by testing red cells with the lectin from *Dolichos biflorus*. Prospective study on 2000 cases to find the frequency of ABO and sub blood groups to reduce the blood transfusion related reactions. **Methods:** The present study included 2000 blood sample collected in the Department of Blood Banking, Govt. Medical College and Hospital, Amritsar and in voluntary blood donation camps organized by the department. 4 ml of venous blood sample collected. 2ml of blood put into ethylene diamine tetra acetic acid (EDTA) vial and remaining 2ml transferred to test tube and allowed to clot. The EDTA sample used for forward grouping and serum used for reverse grouping. **Results:** In our study the frequency of blood group B was the highest 37.8%, blood group O was 31.8%, blood group A was 21.2% and group AB was the least common with 9.2%age. In case of sub groups, A<sub>1</sub> was 20.10% (highest in sub groups) and A<sub>2</sub>B was 0.85% (Lowest). The Rh +ve blood group was 94.1% and Rh -ve was 5.9%. **Conclusion:** The study is concluded with the suggestion that, as already being carried out, ABO, Rh blood grouping and sub grouping should be done in each and every case to reduce the blood transfusion related complications. More work should be carried out in different parts of state to know the distribution pattern of ABO, Rh blood groups and sub groups. This will also help the Blood Banks to estimate the requirement of different blood groups and sub groups.

**Keywords:** Blood Group, Blood Transfusion.

## INTRODUCTION

Blood transfusion in modern era is possible only due to the knowledge of exact blood groups and sub blood groups. Over 700 erythrocyte antigens have been reported and are organized into 35 blood group systems by International Society of Blood Transfusion.<sup>[1,2]</sup> These antigens may be proteins, glycoproteins or glycolipids and are controlled by single or more gene locus. Some antigens are specific to red cells; whereas, others are found on other cells throughout the body.<sup>[3]</sup> The ABO blood group was the first human blood group to be discovered by Landsteiner in 1900 and it served the

beginning of Blood Banking and Transfusion Medicine. In 1902 Decasterllo and Struli discovered the fourth type AB.<sup>[4,5]</sup> The expression of ABO antigen is controlled by three separate genetic loci.<sup>[6]</sup> Numerous mutations are found in A, B and O genes, but the most common mutation is A<sub>2</sub>. The A<sub>2</sub> gene has two nucleotides different from the A<sub>1</sub> gene which results in diminished enzymatic activity and consequently, weakened antigen expression.<sup>[7]</sup> Distinction between A<sub>1</sub> & A<sub>2</sub> made by testing red cells with the lectin from *Dolichos biflorus*.<sup>[8]</sup> The incidence of ABO groups varies very markedly in different parts of the world and in different races.<sup>[9]</sup> Anti-A and anti-B are usually detectable within 3 to 6 months after birth.<sup>[10]</sup> At the age of 5 years, the titers of anti-A and anti-B antibodies reach maximum and persist throughout adulthood. The titers of IgM anti-A and anti-B antibodies may gradually decline with advanced age.<sup>[11]</sup> ABO antibodies are a cause of hemolytic transfusion

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reactions, hemolytic disease of the newborn and acute rejection in solid organ transplantation.<sup>[1]</sup>

**AIMS AND OBJECTIVES**

The present study was taken up with the following aims and objectives:

1. To find frequency of ABO blood group system in the region.
2. To find out the frequency of sub groups A1 A2 A1B and A2B in the region.
3. To find out the frequency of Rh positive and Rh negative in the region.
4. To reduce the incidence of transfusion related reactions by providing appropriate blood group to recipient.

**MATERIALS AND METHODS**

The present study included 2000 blood sample collected in the Department of Blood Banking, Govt. Medical College and Hospital, Amritsar and in voluntary blood donation camps organized by the department. 4 ml of venous blood sample collected. 2ml of blood put into ethylene diamine tetra acetic acid (EDTA) vial and remaining 2ml transferred to test tube and allowed to clot. The EDTA sample used for forward grouping and serum used for reverse grouping.

**Principles of Blood Grouping:**

**Cell grouping:**

1. Forward/Direct grouping is based on an agglutination reaction between A and B antigens

present on RBCs with commercial anti A and anti B antisera respectively.

**Serum Grouping:**

1. Reverse/Indirect or proof grouping is based on an agglutination reaction between naturally occurring anti A and anti B antibodies in serum/plasma with reagent A or B red cells respectively.
2. Blood group A is further divided into A1 and A2 based on reaction with anti A1 lectin (*Dolichos biflorus*). Based on this the ABO blood group system can be divided into six subtypes A1, A2, B, A1B, A2B and O.

**RESULTS**

In our study the frequency of blood group B was the highest and group AB was the least common as shown in [Table 1].

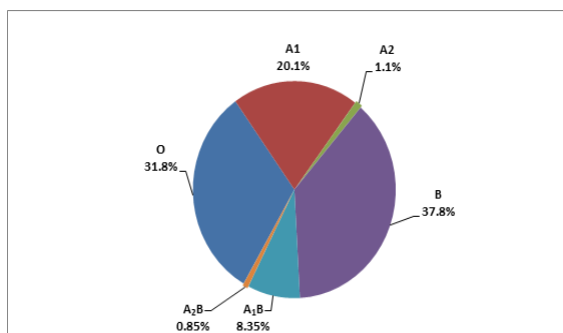
**Table 1: Showing distribution of ABO blood groups**

Blood Group	No. of cases	% age
A	424	21.2%
AB	184	9.2%
B	756	37.8%
O	636	31.8%
Total	2000	100%

The above samples in addition to ABO and Rh were also screened for sub groups of A and AB i.e. A1, A2, A1B and A2B including their Rh blood group typing. The final analysis of the cases shows the frequencies as given in [Table 2].

**Table 2: Showing Distribution of ABO Blood group, sub groups and Rh typing**

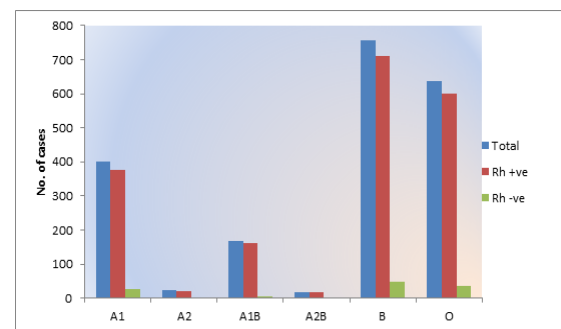
Blood Group & Sub Blood Group	Total no. of cases	Percentage	Rh +ve		Rh -ve	
			No. of cases	%	No. of cases	%
A <sub>1</sub>	402	20.10%	375	18.75%	27	1.35%
A <sub>2</sub>	22	1.10%	21	1.05%	01	0.05%
A <sub>1</sub> B	167	8.35%	161	8.05%	06	0.30%
A <sub>2</sub> B	17	0.85%	16	0.80%	01	0.05%
B	756	37.80%	709	35.45%	47	2.35%
O	636	31.80%	600	30.00%	36	1.80%
Total	2000	100%	1882	94.10%	118	5.90%



**Figure 1: Showing distribution of ABO Sub groups.**

Blood group B+ve was the commonest and A2B+ve was the most uncommon among the ABO +ve blood group. Blood group B -ve was commonest and sub

blood group A2B -ve was least common ABO -ve blood group [Table 2].



**Figure 2: Showing ABO sub groups and Rh distribution**

## DISCUSSION

The greatest challenge to the practice of safe blood transfusion is by the transfusion related complications. A systematic plan of action is needed to minimize these complications by proper identification of blood groups and sub blood groups. Moreover the distribution of ABO, Rh and sub blood groups varies markedly in the different parts of the world and so is in India which is very vast and inhabited by different races and ethnic groups. The quantitative information available regarding distribution of blood groups in different Indian regions is sufficient but the information regarding prevalence of A1, A2, A1B and A2B sub groups, is however less in different races and regions. The present study was therefore undertaken and the frequency of blood group B was found to be highest with 37.8% while AB was lowest with 9.2%. In case of sub groups, A1 was 20.10% (highest amongst sub groups) and A2B was 0.85% (Lowest). The Rh +ve blood group was 94.1% and Rh -ve was 5.9%.[Table 2]

Similarly various studies conducted by different authors show blood group B predominance. Sidhu S (2003),<sup>[20]</sup> Pande P and Singh M (2004),<sup>[15]</sup> Devi OR and Gangadhar M (2006),<sup>[17]</sup> Subhashini AB (2007),<sup>[18]</sup> Various studies from Pakistan also shown similar trend Hameed A et al (2002),<sup>[12]</sup> Anees M and Mirza M (2005),<sup>[13]</sup> Khattak I et al (2008).<sup>[14]</sup> In contrast however, some studies from different regions of India show that the blood group O is most prevalent which is followed by group B whereas AB found to be least common. Dass PK et al (2001),<sup>[19]</sup> Prabhakar S et al (2005),<sup>[21]</sup> Latoo JA et al (2006),<sup>[16]</sup> Periyavan S et al (2010),<sup>[22]</sup> All these studies are in contrast with present study which shows the group B predominance. So it was noted that the ABO blood group distribution was different in different regions of India. In present study Rh +ve was 94.1% and Rh-ve in 5.9% cases whereas different studies from different regions of India show Rh+ve predominance over Rh-ve.(Gauniyal M),<sup>[25]</sup> (Meitei S. and Kshatriya G),<sup>[26]</sup> Different studies reported sub blood groups A1, A2, A1B, A2B, B, O and Rh blood group and sub group distribution from different regions of India are as shown in [Table 3].

**Table 3: Showing comparative A1, A2, A1B and A2B and Rh studies in India**

Author and Region of study with year	A %		AB %		B%	O%	Rh %	
	A1	A2	A1B	A2B			+ve	-ve
Mukhopadhyay R. and Kshatriya G. <sup>23</sup> (HP)* 2004	22.5 26.17	0.83 0.93	11.67 16.82	0.83 0.93	40.0 37.39	24.17 17.76	92.5 95.33	7.5 4.67
Gauniyal M <sup>25</sup> (U)* 2006	40.69	1.13	11.86	0.57	22.03	23.72	67.24	32.76
Pattanayak I <sup>24</sup> (U)* 2006	38.54	0.98	10.24	0.48	25.85	23.91	77.00	23.00
Meitei S. and Kshatriya G <sup>26</sup> (DNH)* 2009	16.5 16.5	1.0 2.91	4.9 5.83	00 00	22.3 34.95	55.33 39.81	99.03 100	0.97 00
Giriyan S, Agrawal A <sup>27</sup> (K)* 2017	25.91	0.30	7.34	0.85	-	-	-	-
Present study (P)*	20.1	1.1	8.35	0.85	37.8	31.8	94.1	5.9

\*HP- Himachal Pradesh, U- Uttaranchal, DNH- Dadra and Nagar Haveli, P- Punjab, K- Karnatka

Mukhopadhyay R. and Kshatriya G. studied the distribution of blood groups among Brahmins and Rajputs of Himachal Pradesh and found that blood group B was highest while among sub groups A1 was most common whereas A2 and A2B was least common.<sup>[23]</sup> Another study conducted in North Karnatka by Giriyan S. and Agrawal A.<sup>[27]</sup> shows predominance of A1 and A2 least common and present study shows almost similar results with A1 preponderance.

Pattanayak I. concluded in distribution of A1, A2, B,O and Rh among the Rajputs of Uttaranchal that blood group A was most prevalent followed by group B which is in contrast to present study however subgroups distribution A1 was highest while sub group A2B was the rarest.<sup>[24]</sup> Gauniyal M. in study of blood group A1, A2, B,O and Rh among Brahmins of Mussoorie Uttaranchal found that blood group A was most common among sub group A1 was the highest with 40.69% and A2B was lowest with 0.57%.<sup>[25]</sup> Sub groups findings well concordance with present study.

Meitei et al studied that distribution of A1, A2, B,O and Rh among the rajputs and Warlis, Dadra and Nagar Haveli, in Rajputs and Warlis sub group A1 was 16.5% while no case related to A2B was found. The Group O was the highest in both the populations.<sup>[26]</sup> All these findings are in contrast to present study.

In the light of above facts it is suggested that there is significant difference in the distribution of ABO blood groups and sub groups in the different regions of our country. As a whole Blood group O is most prevalent followed by group B, However in north India (Punjab) group B is more common followed by group O. In all the study groups, sub group A1 was found to be most common and A2B was the least common.

## CONCLUSION

The study is concluded with the suggestion that, as already being carried out, ABO, Rh blood grouping and sub grouping should be done in each and every

case to reduce the blood transfusion related complications. More work should be carried out in different parts of state to know the distribution pattern of ABO, Rh blood groups and sub groups. This will also help the Blood Banks to estimate the requirement of different blood groups and sub groups.

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