Frequency of the $A_2$-Subgroup Among Blood Group A and Blood Group AB Among Students of Faculty of Medicine and Health Sciences at Alimam Almahalde University, White Nile, Sudan

Abstract

Background: ABO blood group system plays a vital role in transfusion medicine, genetics understanding, inheritance pattern, and disease susceptibility; therefore, it is fundamental to have information on the distribution of these blood groups among any population. There is very slim published data about distribution of ABO blood groups in Sudan and lesser about subgroups.

Methods: Blood samples were collected from 100 students in faculty of Medicine, Al imam Al Mahdi university, Kosti, White Nile state, Sudan. Students were known to have either A or AB blood groups and were typed for A1 and A2 subgroups as well as RhD antigen.

Results: Among the A group there are 93.42% A1 subgroup and 6.6% A2 subgroup. Among the AB group there were 91.6% A1B and A2B was 8.33%.

Conclusion: Frequency of A2 subgroup among A and AB blood phenotypes are equal in Sudanese.

Keywords: Blood; Group; Subgroup A; Subgroup A$_2$; Sudanese

Introduction

Antigens of the ABO blood group system (i.e., A, B, and H antigens) and Rhesus factor were discovered more than one century ago by karl & steiner [1,2] who is considering the father of transfusion medicine, and with this discovery he enabling physicians to transfuse blood without endangering the patient’s life. The ABO antigens are defined by carbohydrate moieties on the extracellular surface of the red blood cell (RBC) membranes [3], but they are also highly expressed on the surface of a variety of human cells and tissues, including epithelium, sensory neurons, platelets, and vascular endothelium [4]. The ABO and Rh blood group system remain the most important blood group systems and the classical immuno genetic markers [5,6]. Blood group antigens play a vital role in transfusion medicine, genetics understanding, inheritance pattern, and disease susceptibility [7]. ABO and Rh D system also have a key role in evolutionary biology, anthropology, studying migration patterns, forensic pathology, and medico-legal issues such as unmatched pregnancy and disputed paternity [8]. The frequency of ABO blood groups varies greatly in different races and populations. In most populations, about 50% are Group O, followed closely by Group A, with groups B and AB showing a much lower incidence [4].

ABO subgroups are distinguished by decreased amounts of antigens on RBCs and, in secretors, present in the saliva [3]. Variation in A antigen expression was recognized early in the twentieth century [11] and the A blood group was divided into A$_1$ and A$_2$ [12,13] which are the two principal A subgroups. Subgroups weaker than A$_1$ are not frequent, and are characterized by a decreasing number of A antigen sites on the RBCs and a reciprocal increase in H antigen activity. Other subgroups of A include A$_{1x}$, A$_3$, A$_{ew}$, A$_{w}$, and A$_{f}$, are met only rarely in transfusion practice, and the last cannot reliably be identified on the basis of the frequency of the common A subgroups varies greatly among different populations. Approximately 80% of blood type A or AB are classified as A$_1$, or A$_2$B, the remaining 20% are either A$_1$ or A$_2$B [14,15]. In study from India the frequency of A$_1$ and A$_2$ subgroups among A blood group was respectively 98.14% and 1.07%, in the AB group the frequency of A$_2$B was 89.28% and that of A$_1$B was 8.99%, this report described the proportion of A$_2$B among AB samples as significantly higher than that of A$_1$ in group A samples [16] and approximately the same distribution is obtained by Bangera [17]. In general frequencies of A$_1$ and A$_2$ phenotypes are compatible with the Hardy-Weinberg equilibrium for the Mendelian inheritance of the allelic A and A$_2$ genes, but in some populations, such as blacks and the Japanese, the frequency of the A$_2$ phenotype is significantly higher than the expected frequency based on the frequency of the A$_1$ phenotype [18,19].

A$_1$ and A$_2$B individuals may have anti-A$_1$ in their serum, which appears as an atypical cold agglutinin [16]. Approximately 0.4% of A$_2$ and 25% of A$_2$B individuals have anti-A$_1$ in the serum [20], these antibodies become clinically significant when react at 37 °C and cause extensive destruction of A$_1$ cells [21,22]. These an-
Antibodies can interfere in routine blood grouping and can give incorrect blood typing or can rarely cause haemolytic transfusion reactions [17].

In Sudan there is very slim published data about distribution of ABO blood groups [23,24], frequency of the Rh antigens [25] and only one report [26] described the general frequency of A and A₂ among the blood donors and to the best of our knowledge there is no published work in the literature regarding distribution of subgroups A₁, A₂ among individuals of group A neither distribution of subgroups A₁, A₂,A,B among individuals with group AB in Sudan. So in this study we aim to determine the frequency of subgroups A₁, A₂ among individuals of group A and AB respectively in the students of Faculty of Medicine and Health Sciences at Alimam Al Mahdi university, Kosti, White Nile, Sudan.

Materials and Methods

100 students known having blood group A or AB were recruited for this study after an oral informed consent had been obtained. Standard method for ABO blood group was used to confirm the blood group and Rh status. Samples were further tested with anti-A lectin to classify them into A₁, A₂. Whenever the agglutination was 4+ with anti-A antisera but negative with anti-A₁ lectin, the sample was considered as A₂ subgroup. The significance of differences in proportions was analyzed using percent test.

Results

Distribution of A and AB blood groups in the total population of the study is shown in (Table 1). 97% of the total sample were positive for Rh D antigen. Distribution of A subgroups and AB subgroups among A and AB respectively are shown in (Figure 1 & 2). Frequency of A₁B subgroup among AB group was slightly higher than frequency of A₂ among A group (Table 2) but was statistically insignificant (percent test). Ratio of A₂/A₁ is 0.07 and that of A₁B/A₂B is 0.09.

Figure 1: Distribution of A₁ and A₂ subgroup among A group (%).

Figure 2: Distribution of A₁B and A₂B subgroup among AB group (%).
Discussion

The frequency of the common ABO phenotypes (A, A2, B, AB, A, B and O) varies greatly among different populations [14,27]. Populations with a high frequency of A phenotype are found mainly in Northern and Central Europe. The B phenotype is most frequent in Central Asia and almost absent in Amerindians. Blood group O is the most frequent phenotype in a global perspective [4]. In this study 100 blood samples were collected from students of faculty of Medicine, Al imam Al Mahdi University, they were known to have either A or AB blood group and this was confirmed in each sample. Among this studied sample there were 76% group A and 24% group AB (Table 1) and this is in consistency with the previous studies done in Sudanese [25,26] which also showed a higher frequencies of A group than AB group. 97% of our population were positive for RhD antigen which matches previously reported per cents in Sudanese [25,26]. Our results showed that A1 is the commonest sub group among A group (Figure 1) and A, B is the commonest subgroup among AB group (Figure 2) which is in agreement with [16,18,28] which reported the same distributions in Indian, Japanese and South Africans respectively. Which means that A1 and A2B are rare subgroups. But still they are important because anti-A1 antibodies occur in sera of A2 groups and more common in A, B subgroups [20] and can be encountered during clinical practice [29] causing difficulties in blood typing [30], hemolytic transfusion reaction [22] and complicate organs transplantation [31]. In this study the frequency of AB subgroup in AB group is slightly higher than that of A1 subgroup in A group (Table 2), but this difference is statistically insignificant, so the frequencies of A1 and A2B among A and AB groups respectively are in balance, which is in agreement with studies done in Caucasian population [14,28], but in contrast to studies done in blacks population [14,28], Indian [16], Japanese [18] and Chinese [33] because studies performed among all those populations reported imbalance in the frequencies of A1 and A2B in A and AB positive individuals, respectively. This imbalance in blacks has been explained by domination of the B gene on phenol typing expression of A, B causing this A1 to be expressed as A or A1, leading to A, B excess [28,34,35]. In Japanese the higher frequency of A1 in AB group was explained by the different expressions of the allele R101, which is expressed as phenotype A in *R101/O heterozygous individuals, but as phenotype A in *R101/B hetero zygo tes, thus giving rise to a higher A, B phenotype frequency [19]. This super active B gene has been reported as a control for expression of the super active B* enzyme, exists in both blacks and Japanese [18].

Conclusion

In conclusion frequency of A1 subgroup among A and AB blood phenotypes are almost equal in Sudanese, which is a surprise, because Sudanese ethnic groups are mainly African and the balanced distribution is a character of Caucasian groups. This can be related to the fact that Sudanese are a mixture of different ethnic groups [36].

References


Table 1: Distribution of A and AB Blood Groups among the study population.

<table>
<thead>
<tr>
<th>ABO blood group</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>76</td>
<td>76%</td>
</tr>
<tr>
<td>AB</td>
<td>24</td>
<td>24%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2: Distribution of A and AB subgroups among A and AB groups.

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Subgroup</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A1</td>
<td>71 (93.42%)</td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td>5 (6.58%)</td>
</tr>
<tr>
<td>AB</td>
<td>A1B</td>
<td>22 (91.67%)</td>
</tr>
<tr>
<td></td>
<td>A2B</td>
<td>2 (8.33%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
</tr>
</tbody>
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13. Camp FR, Ellis FR (1966) Selected contributions to the literature of blood groups and immunology. US Army Medical Research Laboratory, Fort Knox, USA.


