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Erythrocyte Phenotyping in ABO, RH and Kell Blood Group Systems in the Donor and Recipient of Blood Products at the Yaounde University and Hospital Center

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In order to prevent post transfusion alloimmunization, it is essential to give recipients compatible blood products. However in countries with limited income, blood grouping is limited to the ABO system and to the D antigen of the Rhesus system; however, there are other immunogenic antigens such as C, c, E, e and K to name a few. This should be the reason why a retrospective study by Tayou et al. at the blood bank of the University Hospital Center (CHU) of Yaoundé in 2009 on the erythrocyte phenotype in the donor and recipient of blood product only reported to us that data relate to the erythrocyte blood group system ABO and the Rh 1 antigen. We therefore found it expedient to carry out erythrocyte phenotyping in the ABO, RH and KELL blood group systems in the donor and recipient of blood products at the CHU of Yaoundé.

A descriptive, transversal and prospective study was carried out at the blood bank of the CHU of Yaoundé over 6 months, from June 1, 2017 to December 31, 2017. It was interested in the donor-

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recipient couples of blood within which the recipient was a patient hospitalized at the CHU. Laboratory analyses of donor and recipient blood samples have allowed us to have the phenotypes in the ABO, RH, and KELL blood group systems.
In the ABO system, the phenotypes obtained were 4: A1, A1B, B and O at 27.27%, 2.27%, 13.64% and 56.82% respectively among donors and 31.82%, 2.27%, 13.64% and 52.27% among recipients. In addition, from the Rhesus system, there were 5 phenotypes in donors: D + C + E + c + e +, D + C + E-c + e +, D + C-E + c + e +, D + CE-c + e +, DCE-c + e + respectively at 2.27%, 11.36%, 9.09%, 75.00% and 2.27% and in recipients 4 phenotypes, namely: D + C + E + c + e +, D + C-E + c + e +, D + CE-c + e +, DCE-c + e + at 15.91%, 27.27%, 54.55% and 2.27% respectively. In the KELL system, the K antigen was present in 4.55% of donors and 2.27% of recipients. An antigen supply from the donor to the recipient was evaluated at 6.82% for C, 4.54% for E, 2.27% for K and 2.27% for K, C, E at the same time. This gave us an estimate of the average risk of alloimmunization at 15.9%.
Erythrocyte phenotyping would therefore be of major benefit during blood transfusion and would considerably prevent the risks of alloimmunization.

Keywords: ABO; RH; KELL; phenotypes; prevalence; alloimmunization; CHU Yaoundé.

1. INTRODUCTION

Post-transfusion anti-erythrocyte alloimmunization is the immune response developed by individuals transfused with incompatible red blood cells [1]. It manifests itself on the biological level by the appearance in the serum of anti-erythrocyte allo-antibodies which can be responsible for more or less serious hemolysis [2]. Administering compatible blood products is therefore essential. Research of the erythrocyte phenotype will make it possible to know the different antigens of the systems found on the surface of an individual's red blood cells [2]. In France, the ABO-RH1 grouping and the search for RH and KELL phenotypes are carried out systematically [3]; as for the developing countries, they devote a low budget to blood transfusion which just allows to practice the ABO and Rhesus D grouping essential to deal with the medical emergency [4]. A retrospective study conducted at the CHU Yaoundé blood bank in 2009 by Tayou and al. on the erythrocyte phenotype of blood product donors and recipients reported that the data mainly relate to the ABO erythrocyte blood group system and the D (Rh1) antigen [4]. However, there are other immunogenic systems and antigens like the Kell, Duffy, Kidd systems and the C (Rh 2), E (Rh 3), c (Rh 4), e (Rh 5) antigens [5]. In order to contribute to the prevention of the occurrence of transfusion alloimmunization in the recipient, it seemed appropriate to us to undertake this study entitled: erythrocyte phenotyping in the ABO, RH and KELL blood group systems in the donor and the recipient of blood products at the CHU of Yaoundé.

2. METHODOLOGY

We conducted a prospective, transversal and descriptive study at the blood bank of the University Hospital Center (CHU) of Yaoundé. An exhaustive consecutive sampling over a period of 6 months, from June 1, 2017 to December 31, 2017 was made. The donor-recipient blood pairs were included in which the recipient was a patient hospitalized at the CHU. Excluded were recipients who had been transfused less than three months prior to enrollment in the study and therefore the couple's donor. Donor samples were taken during blood donation by correct puncture of a peripheral vein in tubes containing an anticoagulant which was EDTA (Ethylene Diamine Tetraacetic). The blood samples were stored at 4°C before analysis. In recipients, the blood used was drawn into an EDTA tube by the hospital department in which the recipient was located.The technique used during our study was that by agglutination on gel card for the grouping A, B, O, Rh1 and the search for antigens C, E, c and K. The data collection was carried out using a pre-established data collection questionnaire. The variables studied were socio-demographic, clinical and biological. The data were encoded and processed using Epi-Info 7 and Excel 2007 software. They were analyzed using SPSS 20 software.

3. RESULTS

We were able to recruit a total of 88 patients, including 44 donors and 44 recipients. Male subjects predominated among donors at 86.36% (38) for a sex ratio of 6.33. In contrast, the

female sex was predominant at 56.82% (25 cases) among recipients with a sex ratio of 0.76.The average age of blood donors was 27 years, with a standard deviation of 7 years. The latter were mostly young: 31.82% (14) were between 25 and 30 years old. 47.73% (21) of the blood donors were students.In our sample, 54.55% (24 cases) of recipients were over 35 years of age.

The clinical profile of recipients was dominated by moderate or severe anemia at 65.91%.

The phenotype O was the most represented in the donors of our sample at 56.82% or 25 cases, followed by the phenotype A1 represented at 27.27% or 12 cases.

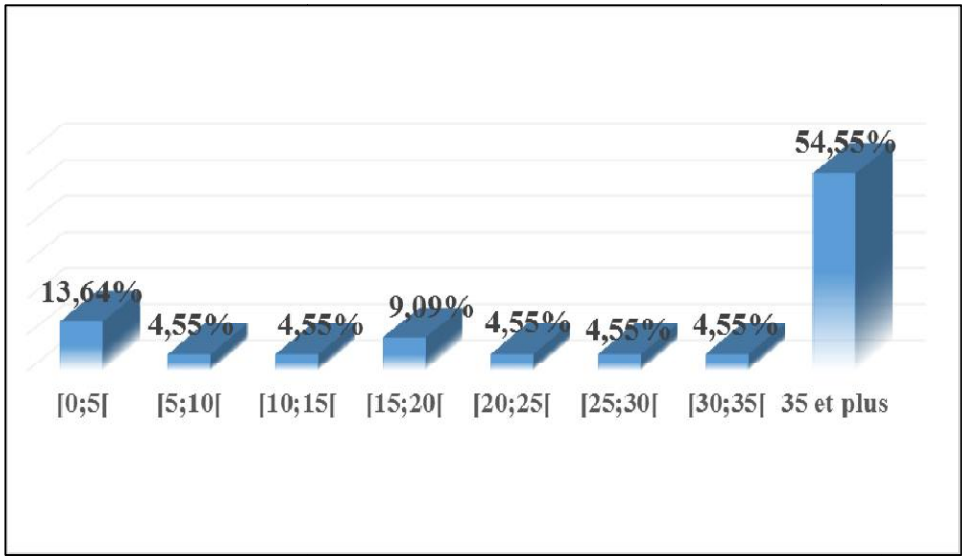

Fig. 1. Distribution of recipients according to age group

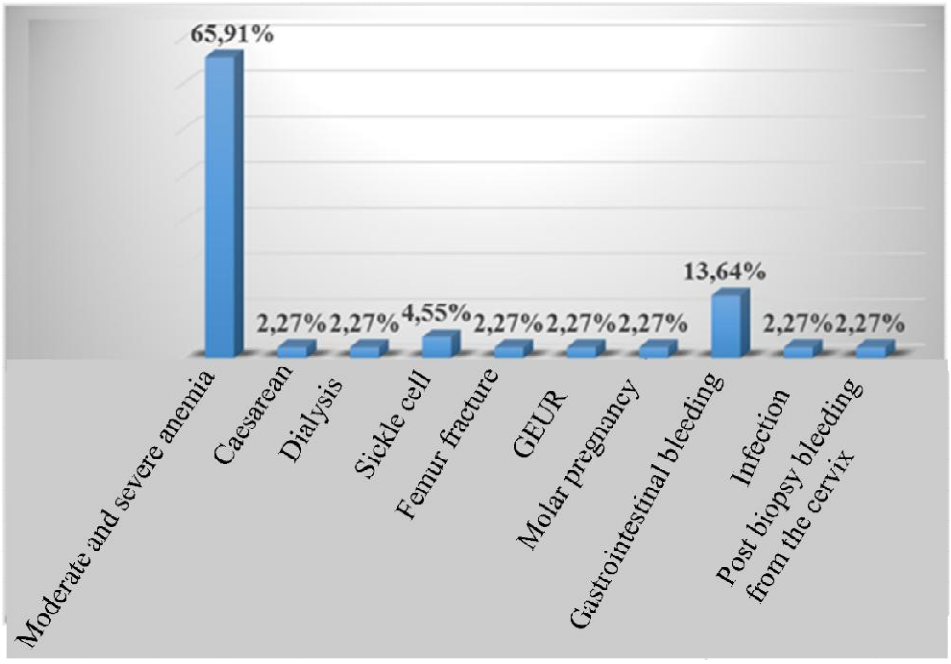

Fig. 2. Clinical presentation of recipients

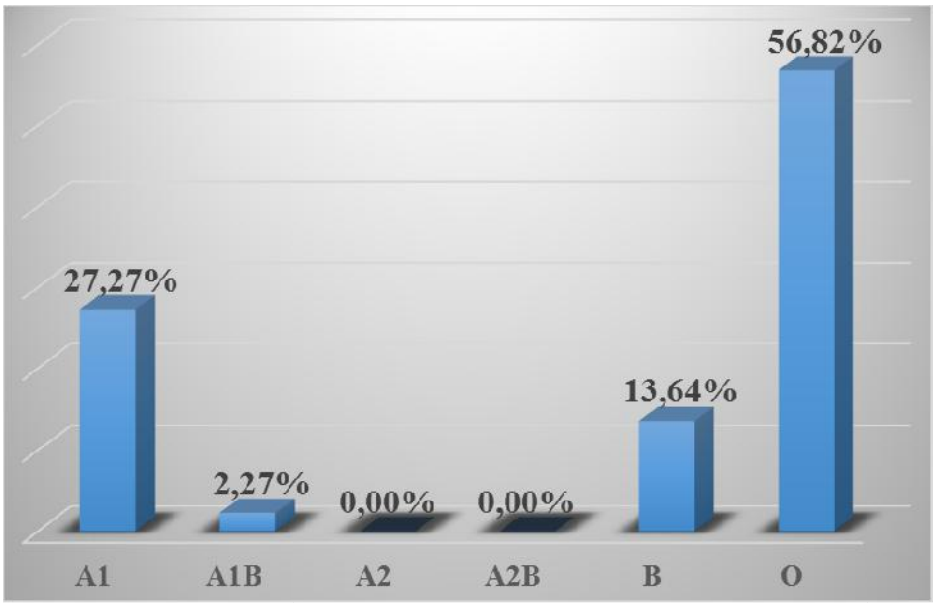

Fig. 3. Donor phenotype in the ABO system

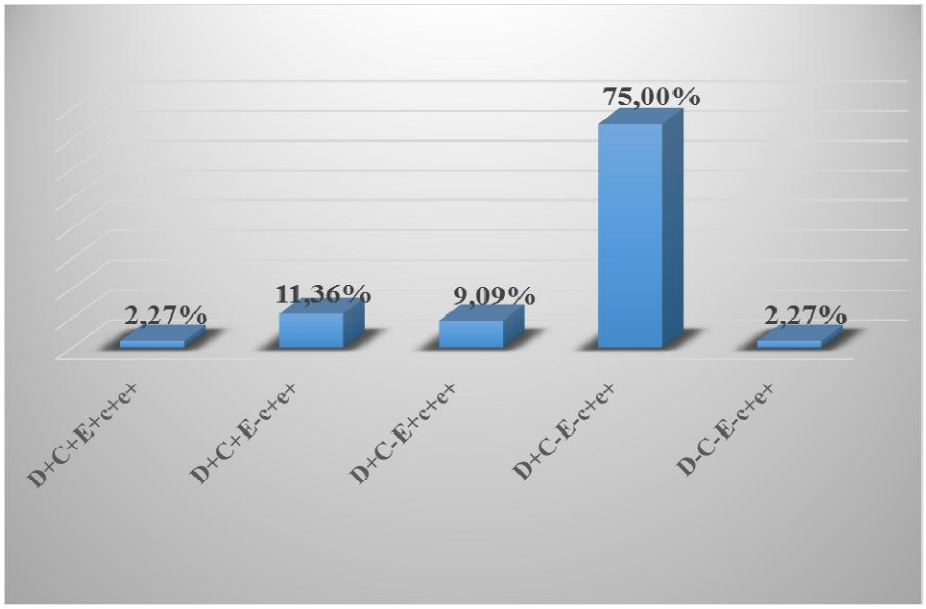

Fig. 4. Donor phenotype in the HR system

The D (Rh1) + C (Rh2) - E (Rh3) - c (Rh4) + e (Rh5) + phenotype predominated at 75% (33 cases) in donors. The latter all presented the antigen c (Rh4), and e (Rh5). Antigen D (Rh1) and antigen K were found in 97.7% (43 cases) and 4.55% (2 cases), respectively, of blood donors.

In recipients, the most common phenotype was 52.27% O, or 23 cases; followed by A1 (31.82% or 14 cases).

The phenotype D + C-E-c + e + was most common in recipients at 54.5% (24 cases). All recipients had antigen c (Rh4) and antigen e (Rh5). The D (Rh1) antigen was found in 97.7% (43 cases) of recipients. The K antigen was 2.27% (1 case) in blood recipients.The D-C-E-c + e + phenotype is the rare phenotype, present at 2.27% in donors and recipients. Seven recipients had acquired at least one foreign antigen during the transfusion. The antigens concerned were: K,

C, E. So we had 7/44, or 15.90% of recipients who were at risk of alloimmunization.

4. DISCUSSION

Our study shows a male predominance among blood donors at 86.36% against 13.64%; or a sex ratio of 6.33. This corroborates with the results of Tagny et al. who reported in seven (7) French-speaking African countries including Cameroon, that among blood donors there are less than 30% women [6]. Sanogo and al. at the CNTS of Bamako (Mali) in 1998 reported for the donors of his sample a sex ratio of 5.25. This predominance of men could be due to the multiple contraindications of blood donation in women, namely: Pregnancy, breastfeeding, menstruation. In our context, insufficient awareness of the general population and of women in particular in favor of blood donation could also be mentioned because in France in 2013, a study on blood donors found 51.2% of women and 48, 8% of men, which corresponds to a sex ratio of 0.95.

The majority of blood donors were young people and the 25 to 30 age group predominated with a rate of 31.82%. This value is close to that of Mornandji and al. at the CNTS of Bamako (Mali) in 2001 who reported a dominant age group of 26 to 45 years for donors during blood transfusions [7].

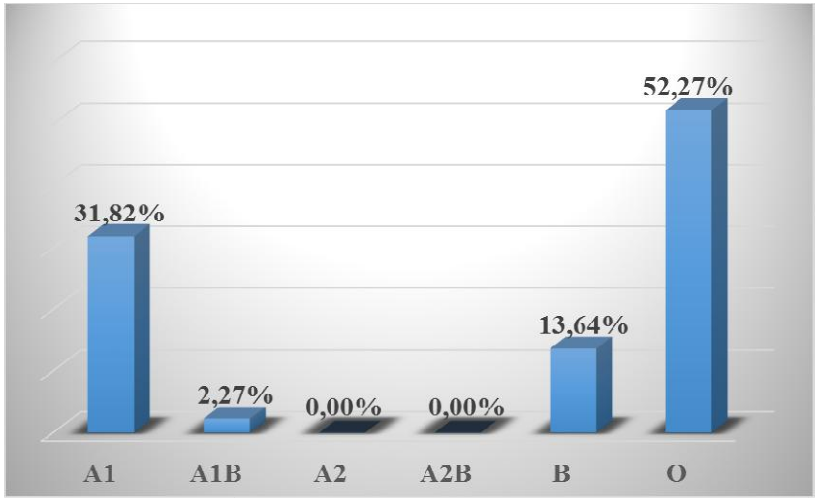

Fig. 5. Recipient phenotype in the ABO system

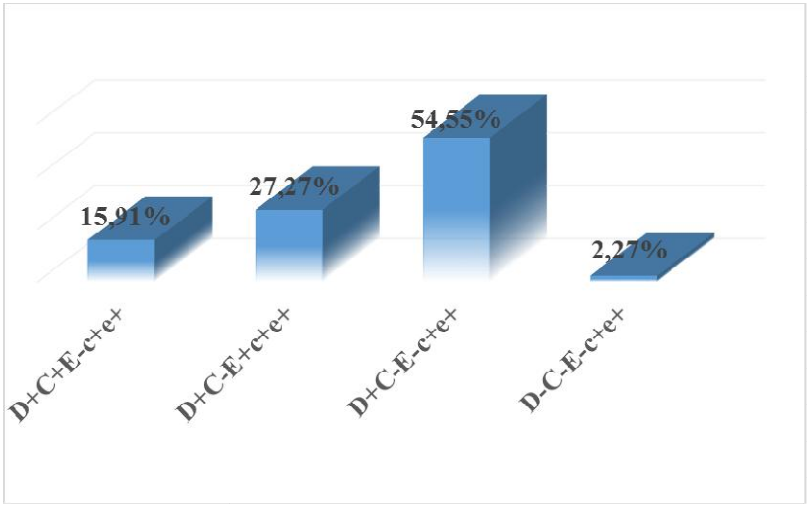

Fig. 6. Phenotype of recipients in the HR system

Many professions are represented among blood donors; however, students were the most represented in frequency (47.73%). This predominance of young people in school is explained by the high number of mobile collections made in university establishments.

Females predominated in recipients with a sex ratio of 0.76. This high prevalence of women in our sample can be explained by a higher susceptibility of women to the disease. In fact, there are genetic theories which describe a greater risk in women of getting infections, gastritis (cases of relatively high number of digestive haemorrhages), autoimmune diseases [8]. Also, among the reasons for transfusions mentioned, many have feminine connotations such as post biopsy bleeding from the cervix, GEUR (ruptured extra uterine pregnancy), molar pregnancy, and cesarean section.

The predominant blood groups in our sample were O, followed by blood groups A and B. Blood group AB was rare. This result agrees with that of other authors: Tayou, and al. who had found at the CHU of Yaoundé (Cameroon): the phenotype O (51.3%), A (24.2%), B (18.8%) and AB (5.7%) [4]; Iyiola, and al. in southwest Nigeria at Lagos which reported the following phenotypes: O (52.9%), A (23.1%), B (21.3%) and AB (2.7%) [8]. On the other hand, our results are different from those obtained from Asian donors according to the study by Mwangi et al in 1999: 34% (O); 26% (A); 33% (B); AB (7%) [9]. This difference may be due to genotypic differences between the population of our study (African) and the Chinese population (Asian).

The majority phenotype in the donors and recipients of our study was D + C − E − c + e + in agreement with Traoré et al. in Bamako who reported the same result in 2002 [10]. Siransy et al. Found in ivory coast in 2014 in blood donors for the antigens D, C, E, c, e, 92.93%; 21.97%; 13.82%; 99.85%; 99.85% respectively [11]. The antigens taken separately showed that the D antigen is present in 97.7% of our blood donors and 2.3% did not. Tayou, and al. had found, at the CHU of Yaoundé (Cameroon) in 2009 that 97.6% of donors had the Rh D antigen and 2.4% did not [4]. Lyko and al. in 1992 in Kenya found that Rh D + was present in 96.1% of donors and 3.9% did not [12]. Avent et al. [5] reported 97% Rh D + and 3% Rh D- in blacks; on the other hand they found 99% of RhD + in Asians and 61% of Rh D + in Caucasians [13].

The K antigen was present in 5% of blood donors and only 2% of recipients. This difference in rate could be due to an insufficient sample for the donor and recipient groups. In our sample, 97.6% of blood recipients lacked the K antigen and only 2.4% had it. However, 5% K antigen has been found in blood donors, which puts recipients at risk for anti-K alloimmunization. Wagner et al. (1995) in their study found that 96% of their population did not have the Kell antigen [14]. Studies by Lee and al. in 1997 reported the presence of the K1 antigen in 2% of blacks.

In the case of transfusion alloimmunization, the antibodies most frequently encountered are antibodies of the Rhesus system, mainly anti-D, anti-E and anti-C, followed by anti-Kell. In our study this event occurred with a frequency of 4.54% in two couples, for the E antigen, 6.82% in 3 couples for the C antigen, 2.27% in 1 couple for the K antigen only and 2.27% in 1 couple, for K, C, and E antigens simultaneously. This makes a total of 15.90% risk of alloimmunization in recipients in our study. For the recipient, a risk of anti-K, anti-C, anti-E alloimmunization therefore exists, if pheno-compatible transfusion in the Rhesus and KELL systems is not the rule, since allo - transfusion immunization partly depends on the antigenic differences between donor and recipient, Vichinsky and al. had found up to 30% of allo-immunization cases in polytransfused patients. In sickle cell patients, an incidence of anti-erythrocytic alloimmunization of the order of 4 to 40% has been reported. In addition, antibodies have been described in transfused sickle cell patients.

5. CONCLUSION

In view of this prospective work, erythrocyte phenotyping during blood transfusions is of essential importance, in particular for the prevention of alloimmunizations. It is not only a question of studying the erythrocyte blood group system ABO and the D antigen (Rh1) but also of other immunogenic systems and antigens like the Kell, Duffy, Kidd and C antigens systems (Rh 2), E (Rh 3), c (Rh 4), e (Rh 5). 15.9% of recipients in our study, for example, were at risk of alloimmunization.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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