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# ANALYSIS OF THE ERYTHROCYTE ALLOIMMUNIZATION PROFILE OF WOMEN WITH BREAST CANCER

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Objective: To describe the erythrocyte alloimmunization profile of women diagnosed with breast cancer at the National Cancer Institute, basedonacomparisonbetweenroutineantibodyandirregularenzymetechniques. Methods: Experimentalandprospective study with the application of human antiglobulin techniques and enzymatic technique in the search for irregular antibodies in pre-transfusion tests of women with breast cancer treated at the hemotherapy service of Hospital do Câncer III, between June 2020 and May 2021. The variables were compared using Pearson's $\chi^2$ test or G-test, when indicated. Results: 429 cases were included. Of the total, 8 (1.86%) presented positive antibody screening test in routine human antiglobulin technique, while 32 (7.6%) were observed in the enzymatic technique. Significant differences were observed between alloimmunized and non-alloimmunized patients regarding ethnicity, RhD classification, transfusion history and alloantibody incidence time. Conclusion: The application of the enzymatic technique is proposed as a routine method in patients with breast cancer, as a way of avoiding transfusion reactions and ineffective phenotypetransfusions.

KEYWORDS: Women's health; breast neoplasms; blood group antigens; isoantibodies

## INTRODUCTION

Alloimmunization against erythrocyte antigens is an increasingly common problem in oncology patients undergoing transfusion, even in those who are transfused sporadically, such as patients with breast cancer. Since irregular antibodies occur in approximately 0.3–2% of the general population, screening and identification of antibodies are indispensable for proper blood selection for transfusion. Information regarding age, sex, race and clinical, transfusion, and pregnancy histories may provide clues to the identification of these antibodies. The chance of finding irregular antibodies in the serum of receptors increases mainly among females, due to the chance of exposure before pregnancy[1].

The detection of irregular antibodies must be performed with a sensitive technique, capable of detecting antibodies of greater clinical relevance. Failure to detect an alloantibody can lead to acute or late hemolytic transfusion reactions with intensities that may range from mild to severe and further impair the clinical condition of the recipient. Many irregular antibodies disappear over time and may reappear after a new antigenic stimulus. In addition to the low titers, the presence of autoantibody may also mask the presence of alloantibodies of clinical importance[2].

Hospital do Cancer III (HCIII) mainly serves the female population with a diagnosis of breast cancer. It is a reference for using screening techniques capable of potentiating the identification of antibodies of clinical significance. The set of tests performed before a transfusion is known as pre-transfusion testing. Every transfusion candidate should have a sample of their blood drawn for testing the presence of antigens and antibodies in their red blood cells and serum/plasma, respectively. According to Ordinance No. 158, dated February 4, 2016, from the Brazilian Ministry of Health, mandatory procedures include blood typing for ABO and RhD (Rh blood group D antigen) blood group sys- tems, irregular antibody screening (IAS) and cross-matching[3]. Currently, the procedures applied to IAS at HCIII are incuba- tion at 37ºC with antiglobulin test (AGT) and gel centrifugation technique. With the current screening technique, the frequency of irregular antibodies is 1.25% out of 2,396 patients assessed in the period between 2011 and 2013. It has been shown that approximately 83% of the irregular antibodies identified in this group of patients may present increased reactivity in an enzymatic medium[4].

Proteolytic enzymes may enhance the reactivity of some alloantibodies by enzymatic treatment of test red cells. They are especially indicated as an accessory method of identification in cases of antibody mixing, or even in cases of clinically important antibodies but in low titers. Enzyme-treated hemocytes will have the antigens M, N, S, s, Fya and Fyb destroyed and will fail to react with antibodies from the tested serum. On the other hand, Rh, Kell, P, I, Kidd and Lewis blood group antigens will not be destroyed and react more strongly with their antibodies[5].

As the behavior profile of irregular antibodies is not yet well known in this group of patients, the present study aimed to com- pare AGT and enzyme techniques, and to describe the alloim- munization profile of breast cancer patients at the HCIII.

## METHODS

We performed an experimental and prospective study to ana- lyze erythrocyte alloimmunization in a period of one year(June 2020–May 2021).

The study was carried out at the transfusion center of HCIII, a hospital unit of the Brazilian National Cancer Institute (INCA), located in the city of Rio de Janeiro. Participants in this study included patients with a baseline diagnosis of breast cancer (ICD C50). The inclusion criteria for participation in the study were: female patients treated at chemotherapy, clinical oncology, mastology and surgical centers of the institution. We excluded male patients, female patients who did not continue treatment at the institution and patients suspected of using of anti-D immunoprophylaxis.

We selected peripheral blood samples from included patients for analysis. All samples were submitted to IAS by Liss-AGT and Nacl/enzyme techniques. In cases of positive IAS, we identified the irregular antibody specificity in the corresponding technique. Positive antibody screening patients were invited to partici- pate in the present study through a formal interview in a suitable environment in order to preserve their privacy. All the patients who accepted to participate in the study signed an informed con- sent form (ICF). We used a questionnaire to verify alloimmuni- zation profiles and collect sociodemographic and clinical data, which included age, ethnicity (white, black, mulatto and Asian), blood group (A, B, AB and O) and transfusion and pregnancy histories. Pregnancy history was represented by the number of previous pregnancies (zero, one, two or more). Transfusional his- tory was represented by two variables: number of transfusions outside the institution and number of transfusions at the insti- tution (one, two, three or more).

Ordinal and nominal variables were compared by Pearson's $\chi^2$ test, or G-test, when indicated. Statistical analysis was per- formed using the Bioestat statistical package (version 5.0, 2015). We developed a logistic regression model to identify the variables independently, considering a significance level of 0.10.

This study was approved by the Research Ethics Committee of Hospital das Clínicas, Medical School of Ribeirão Preto (protocol CAAE-41619415.9.0000.5440), under the title *Avaliação da imple- mentação da pesquisa de anticorpos irregulares com hemácias tratadas com enzima nos exames pré-transfusionais de pacien- tes com neoplasia maligna de mama do Instituto Nacional do Câncer*. All recommendations of good clinical practices were fol- lowed in accordance with the Resolution of the Brazilian National Health Council (CNS) nº 466/2012 and the Helsinki Convention.

## RESULTS

From June 2020 to May 2021, blood samples were collected from 429 breast cancer patients who were treated at the transfusion center of HCIII, part of the Brazilian National Cancer Institute (INCA). The samples were obtained from pre-transfusion immunohematological tests, of which 112 were transfusion requests and 317, surgical reservations. Of the total, 8 (1.86%) showed positive IAS results by Liss/AGT technique in routine screening. Irregular antibodies specificity identification by Liss/AGT revealed 12 alloantibodies, with anti-D being the most predominant in 5 samples (41.6%), followed by 2 anti-E (16.6), 2 anti-C (16.6%), 1 anti-lea (8.4%), 1 anti-Jka (8.4%) and 1 anti-S (8.4%). All 421 samples that showed a negative IAS result with Liss/AGT underwent complementary testing with papainized red cells, which resulted in 32 positive samples (7.6%). Identification of irregular antibody specificity by enzyme technique revealed 37 antibodies. Anti-E was the most predominant in 13 samples (35%), followed by 9 warm public autoantibodies (24%), 7 anti-Lea antibodies (19%) 4 Anti-D (11%), 1 anti-C (2.75%), 1 anti-Cw (2.75%), 1 anti-K (2.75%) and anti-Dia (2.75%) (Table 1).

The 429 studied patients (40 alloimmunized and 389 non-alloimmunized) were analyzed together as to: age group and ethnicity; ABO/Rh typing; transfusion and pregnancy histories; time between antibody identification by Liss/AGT or enzyme techniques; last pregnancy; and last transfusion.

Regarding age, 147 patients (34.2%) were between 18 and 49, 216 (50.3%) between 50 and 69 and 66 (15.5%) were 70 years or older. Among the alloimmunized patients, 23 (57.5%) aged between 50 and 69 years and 193 (49.6%) non-alloimmunized patients belonged to the same age group. Despite the higher concentration of alloimmunized and non-alloimmunized patients in the intermediate age range (50–69 years), there was no statistically significant difference between the groups ($\chi^2$; p = 0.4314).

In relation to ethnicity, 192 (44.7%) patients were white, 150 (34.9%) were mulatto, 81 (18.8%) were black and 6 (1.6%) were Asian. Among the alloimmunized patients, 20 (50%) were white, 9 (22.5%) were mulatto, 9 (22.5%) were black and 2 (5%) were Asian, whereas the percentages among non-alloimmunized patients were 44.2%, 36.2%, 18.5% and 1.1%, respectively. Most patients described themselves as white people, with an observed statistically significant difference between the two groups ($\chi^2$ test, p = 0.0847) (Table 2).

As for ABO typing, 189 patients (44%) belonged to blood group O; 162 (37.7%) A; 63 (14.7%), B; and 15 (3.6%), AB. The most prevalent blood type among the alloimmunized patients was group O, 19 patients (47.5%), followed by A, 13 patients (32.5%). The most frequent ABO types among non-alloimmunized were also O (43.7%) and A (38.3%), with no statistically significant difference between the two groups (G-test, p = 0.8779). As for RhD typing, 382 (89%) were RhD positive and 47 (11%) were RhD negative. The predominance of RhD positive was verified in both groups, with 75% and 90%, respectively. A statistically significant difference was observed between the groups (G-test, p = 0.0147) (Table 3).

Of the total studied patients, only 65 (16%) had a history of transfusion. Among the alloimmunized patients, 29 (72.5%) had not received previous transfusions and 11 (27.5%) received transfusions of packed red blood cell at HCIII before the irregular antibody identification by this study. Among the non-alloimmunized patients, 335 (86%) had no transfusion history, determining a statistically significant difference between the two groups ($\chi^2$ test; p = 0.0398). Regarding the number of red blood cell transfusions at HCIII, 31 patients (47.7%) received 1-2 transfusions, 22 (33.8%) received 3-4 transfusions, and 12 patients (18.5%) received 5 transfusions or more. Of the total alloimmunized patients, 6 (54.5%) received up to 2 transfusions, 3 (27.3%) received 3–4

**Table 1.** Percentage Distribution and specificity of erythrocyte alloantibodies, Rio de Janeiro, 2020–2021.

| Alloantibody | INCA's Routine Liss/AGT n (%) | NACL/ENZYME n (%) | Associated techniques n (%) |
|---|---|---|---|
| Anti-D | 5 (41.6) | 4 (11) | 9 (18.7) |
| Anti-E | 2 (16.6) | 13 (35) | 15 (31.2) |
| Anti-C | 2 (16.6) | 1 (2.75) | 3 (6.2) |
| Anti-cw | 0 (0.0) | 1 (2.75) | 1 (2.12) |
| Anti-K | 0 (0.0) | 1 (2.75) | 1 (2.12) |
| Anti-lea | 1 (8.4) | 7 (19) | 7 (14.6) |
| Anti-Jka | 1 (8.4) | 0 (0.0) | 1 (2.12) |
| Anti-Dia | 0 (0.0) | 1 (2.75) | 1 (2.12) |
| Anti-S | 1 (8.4) | 0 (0.0) | 1 (2.12) |
| Autoantibody | 0 (0.0) | 9 (24.3) | 9 (18.7) |
| Total | 12 (100) | 37 (100) | 48 (100) |

INCA: *Instituto Nacional do Câncer* (Brazilian National Cancer Institute); AGT: antiglobulin test.

transfusions, and 2 (18.2%) received more than 5 transfusions. Among the non-alloimmunized patients, the figures were 46.3, 35.2 and 18.5%, respectively. We observed no statistically significant difference between alloimmunized and non-alloimmunized patients (G-test, p = 0.8676). Of the 429 women studied, 387 (90.2%) had a pregnancy history and 42 (9.8%) did not. Of the 40 alloimmunized patients, 37 (92.50%) reported a pregnancy history. Among the non-alloimmunized patients, the vast majority (90%) reported a pregnancy history. There was no statistically significant difference between the two groups ($\chi^2$ test; p = 0.8162). Concerning women with a pregnancy history, 76 (17.7%) had only 1 pregnancy and 311 (72.3%) reported having had 2 or more pregnancies. Among the alloimmunized patients, 5 (13.5%) had only 1 pregnancy and 32 (86.5%) had 2 or more pregnancies. Percentage values for non-alloimmunized patients were 20.3 and 79.7%, respectively. There was no statistically significant difference between alloimmunized and non-alloimmunized patients (G test, p = 0.5128) (Table 4).

In order to analyze the frequency of irregular antibodies of the 387 women with a pregnancy history, we observed the time elapsed between the last pregnancy and the first IAS performed in this study. The results showed that 52 (13.4%) ranged from 1-9 years, 82 (21.2%) 10–19 years and 253 (65.4%) 20 years or more. Of the alloimmunized patients, 5 (13.6%) revealed a frequency of up to 9 years, 8 (21.6%) 10–19 years and 24 (64.8%) 20 years or more. Among the non-alloimmunized patients, the values were 13.5%, 21.1% and 65.4%, respectively. In spite of the higher concentration of alloimmunized and non-alloimmunized in the longest frequency (>20 years), there was no statistically significant difference between the groups (G-test, p = 0.9973). We observed the time elapsed between the last transfusion and the first IAS performed in this study in the 60 women with a history of transfusion in order to estimate the incidence of irregular antibodies. Considering that a secondary immune response can occur within a period of up to 72 hours, the selected patients were distributed in margins of higher and lower values than that time. Of the 60 women studied, 51 (85%) showed time greater than 72 hours and only 9 (15%) presented equal and/or inferior time. All alloimmunized patients (100%) had a result superior to 72 hours. Among the

**Table 2.** Patient distribution according to age and ethnicity, Rio de Janeiro, 2020–2021.

| | Alloimmunized n (%) | Non-alloimmunized n (%) | Chi-square test ($\chi^2$) |
|---|---|---|---|
| Age group (years) | | | |
| 18–49 | 10 (25) | 137 (35.2) | Contingency = 3x2<br>$\chi^2$ = 1.682<br>Degrees of freedom = 2<br>P = 0.4314 |
| 50–69 | 23 (57.5) | 193 (49.6) | |
| 70 | 7 (17.5) | 59 (15.2) | |
| Total | 40 (100) | 389 (100) | |
| Ethnicity | | | |
| White | 20 (50) | 172 (44.2) | Contingency = 4x2<br>$\chi^2$ = 6.628<br>Degrees of freedom = 3<br>P = 0.0847 |
| Mulatto | 9 (22.5) | 141 (36.2) | |
| Black | 9 (22.5) | 72 (18.5) | |
| Asian | 2 (5) | 4 (1.1) | |
| Total | 40 (100) | 389 (100) | |

**Table 3.** Patient distribution according to ABO and RhD typing, Rio de Janeiro, 2020–2021.

| | Alloimmunized n (%) | Non-alloimmunized n (%) | G-test |
|---|---|---|---|
| ABO typing | | | |
| O | 19 (47.5) | 149 (38.3) | Contingency = 4x2<br>Degrees of freedom = 3<br>G test = 0.7119<br>P = 0.8791 |
| A | 13 (32.5) | 193 (49.6) | |
| B | 6 (15) | 59 (15.2) | |
| AB | 2 (5) | 170 (43.7) | |
| Total | 40 (100) | 389 (100) | |
| RhD typing | | | |
| Positive | 30 (75) | 352 (90) | Contingency = 4x2<br>Degrees of freedom = 3<br>G-test = 7.0675<br>P = 0.0147 |
| Negative | 10 (15) | 37 (10) | |
| Total | 40 (100) | 389 (100) | |

non-alloimmunized patients, the same time was present in 41 (82%) patients. When comparing alloimmunized and non-alloimmunized patients, a statistically significant difference was observed (G-test, p = 0.0583) (Table 5).

## DISCUSSION

Regarding the age group of individuals with positive IAS, we observed that the highest frequency of alloimmunization was between 50-69 years (57.5%). Our results were similar to that found in Shin[6], in which alloimmunized cancer patients showed a frequency of 75.4% in the age group over 50 years of age. Our results are inconsistent with those found by Zaman et al.[7] in their study on alloimmunization in hematological and oncological patients in India. They observed that only 28% of alloimmunized patients were older than 50 years of age. Mohsin[8] also presented divergent results from ours. In their study, breast cancer patients accounted for 68% of the analyzed patients and the mean age of the alloimmunized group was 49 years. Despite the low alloimmunization rate in the elderly (≥ 70 years), our study shows that, of all alloimmunized patients, the majority (65.8%) was 50 years of age or older, an index very similar to the control group (64.8%), demonstrating that advanced age could be directly linked to alloantibody titer decay. According to Cozac[9], some vaccine-related studies have shown that aging weakens B and T lymphocyte response to pathogens, thus shortening the duration of

**Table 4.** Patient distribution according to transfusion and pregnancy histories, Rio de Janeiro, 2020–2021.

| | Alloimmunized n (%) | Non-alloimmunized n (%) | $\chi^2$ and G-tests |
|---|---|---|---|
| Transfusion history | | | |
| Yes | 11 (27.5) | 54 (14) | Contingency = 2x2<br>Degrees of freedom = 1<br>$\chi^2$ = 5.232<br>p = 0.0398 |
| No | 29 (72.5) | 335 (86) | |
| Total | 40 (100) | 389 (100) | |
| Number of transfusions | | | |
| 1-2 | 6 (54.5) | 25 (46.3) | Contingency = 3x2<br>Degrees of freedom = 2<br>G-test = 0.3051<br>P = 0.8676 |
| 3-4 | 3 (27.3) | 19 (35.2) | |
| 5 or more | 2 (18.2) | 10 (18.5) | |
| Total | 11 (100) | 54 (100) | |
| Pregnancy history | | | |
| Yes | 37 (92.5) | 350 (90) | Contingency = 2x2<br>Degrees of freedom = 1<br>$\chi^2$ = 0.262<br>p = 0.8162 |
| No | 3 (7.5) | 39 (10) | |
| Total | 40 (100) | 389 (100) | |
| Number of pregnancies | | | |
| 0 | 3 (7.5) | 39 (10.1) | Contingency = 3x2<br>Degrees of freedom = 2<br>G-test = 1.3357<br>P = 0.5128 |
| 1 | 5 (12.5) | 71 (18.2) | |
| 2 or more | 32 (80) | 279 (71.7) | |
| Total | 40 (100) | 389 (100) | |

**Table 5.** Patient distribution according to prevalence frequency and alloantibody incidence, Rio de Janeiro, 2020–2021.

| | Alloimmunized n (%) | Non-alloimmunized n (%) | G-test |
|---|---|---|---|
| Prevalence frequency (years) | | | |
| 1–9 | 5 (13.6) | 47 (13.5) | Contingency = 3x2<br>Degrees of freedom = 2<br>G-test = 0.0054<br>P = 0.9973 |
| 10–19 | 8 (21.6) | 74 (21.1) | |
| 20 or more | 24 (64.8) | 229 (65.4) | |
| Total | 37 (100) | 350 (100) | |
| Incidence time (hours) | | | |
| Less than 72 | 0 (0.00) | 9 (18) | Contingency = 2x2<br>Degrees of freedom = 1<br>G-test = 3.5857<br>P = 0.0583 |
| 72 or more | 10 (100) | 41 (82) | |
| Total | 10 (100) | 50 (100) | |

immune protection, which should also reflect the persistence of the formed alloantibodies.

In our study, we found a predominance of 50% in alloimmunized Caucasian individuals, with a similar rate in the control group (44.7%) and a statistically significant difference ($\chi^2$ test; p = 0.0847). When considering non-Caucasian patients, we observed slightly equivalent rates between alloimmunized (50%) and non-alloimmunized patients (55.8%) and the total number of individuals analyzed (55.3%). With these data, we can infer that erythrocyte alloimmunization occurs from the differences between the erythrocyte phenotypic patterns of the population, whether its exposure is mainly due to pregnancy or from transfusions between donors and recipients. The white predominance in our study over an antigenic exposure of a predominantly brown population in Rio de Janeiro[10] favors erythrocyte alloimmunization.

Among the Brazilian population, the prevalence of the RhD negative phenotype is variable and heterogeneous among the various regions of the country. In our study, the predominance of RhD positive typing was observed in both alloimmunized and non-alloimmunized patients (75 and 90%, respectively). A similar result was observed in a study in Rio de Janeiro, in which the frequency of RhD positive blood donors was 90.2%. The highest proportion of RhD negative women in the alloimmunized group, compared to non-alloimmunized women, falls on the specificity of the irregular antibodies identified in the present study. Based on the assumption that D is considered the most immunogenic of the erythrocyte antigens after the ABO blood group system[10], our study showed anti-D as the main alloantibody identified with AGT.

We observed that 27.5% of the positive IAS patients in our study had a history of transfusion. This result is similar to Alves's findings[11], in which 29.41% of the alloimmunized patients had previously received transfusions. In our study, alloimmunized individuals received between 1 and 7 transfusions of red blood cells, with a mean of 3.18 transfusions per patient, which is in agreement with the literature[6,12]. On the other hand, we observed that the proportion of alloimmunized patients receiving more than 5 transfusions was not statistically significant (p = 0.8676) compared to non-alloimmunized patients, since their values were equivalent (18.2 and 18.5%, respectively). The data obtained were expected, since blood transfusion therapy profile of patients with breast cancer is considered non-chronic. A similar result was obtained in a 20-year retrospective multicenter study with alloimmunized, non-chronically transfused patients, in which 80 individuals (57%) were sensitized after receiving an average of 2 red cell units.[12] This result shows that alloimmunization in our study had no correlation with the number of transfusions received at the institution, but with the transfusion history. This finding reinforces a possible prevalence of preformed alloantibodies in this group of cancer patients.

Although nulliparity is indicated as a breast cancer risk among women[13], our study showed that the vast majority of alloimmunized women had a history of pregnancy (92.5%). Santos[13] showed a similar result, revealing a frequency of 93.33% of alloimmunized women with a history of pregnancy. Natukunda[14], in turn, revealed that only 62.5% of the women who produced alloantibodies had previous pregnancies. However, in our study, one fact draws a lot of attention. Although there was no statistically significant difference (p = 0.8135), this result is exactly the opposite of what was expected, since pregnancies are an important cause of alloimmunization in women[1,7-10,12,14,15]. Therefore, we consider this a casual result.

In all 4 patients in whom post-transfusion alloimmunization was detected, it was found that the time to alloantibody production varied from 5 days to 1 month, with a mean of 21 days, ranging from the time between the first transfusion of the packed red blood cells and alloimmunization identification. Our results are in agreement with a study cited by Bordin[12], in which alloantibodies were detected with an average of 20 days by AGT. Based on these results, our study considered the period between the last transfusion and the first IAS performed by us as a way of obtaining an estimate of the time interval between transfusion and detection of alloantibodies, with a significant statistical difference. Among the alloimmunized patients, we observed that this time ranged from 5 days to 8 months, whereas in non-alloimmunized patients, the observed time ranged from 1 day to 24 months. In the study carried out by Santos[13], the time for alloantibody production ranged from 3-97 days, with an average time of 20.88 days. Schonewille[16] observed that 16.8% of the patients became alloimmunized within 14 days after the transfusions and 2.3% produced alloantibodies within a maximum of 3 days, with anti-E as the most common antibody (42.8%). This result is in accordance with our study, in which 2 (50%) of the 4 alloimmunized individuals developed that alloantibody. When we assessed the 22 alloimmunized patients who only had a pregnancy history, we observed that the persistence of alloantibodies ranged from 2–57 years, with an average of 25.4 years. Applying the AGT technique, anti-D was the main alloantibody, detected in 4 patients (18%). With AGT, the persistence ranged from 15-42 years, with an average of 30 years. However, with the enzyme technique, anti-E was the main alloantibody, detected in 8 patients (36%), with persistence ranging from 2-57 years and an average of 23.5 years. These results demonstrate that the enzyme technique can be used in order to detect alloimmunization in a short time after exposure. In the present study, no alloimmunized patient had only a transfusion history.

## CONCLUSION

The present study showed a frequency of erythrocyte alloimmunization of 9.32%. Screening was performed in breast cancer

patients with a combination of Liss/AGT and enzyme techniques. Our study also revealed that the application of the enzyme method in the irregular antibody screening routine provided a positivity index up to seven times higher than when only the LISS/AGT method is applied.

Most alloimmunized patients presented with alloantibodies of clinical significance (Rh system). We observed that alloimmunization was not correlated with the number of red blood cell transfusions in the institution, confirming the hypothesis of prior alloimmunization, mainly due to pregnancy and transfusion histories. As previous alloimmunization cannot even be detected in the IAS by Liss/AGT, and once it was observed that the time to generate alloantibodies would be long (more than 72 hours), our results demonstrated that the enzyme technique can be used to detect alloantibodies in a short time after the exposure to erythrocyte antigens.

Given these facts, we propose the adoption of the enzyme technique as a routine method. We also propose the extension of this project in pre-transfusion testing routines to the other groups of cancer patients. Such a measure will certainly contribute to reducing erythrocyte alloimmunization rates among recipients of packed red blood cells and politransfused patients. Thereby, it would reduce the risk of incompatible phenotype transfusions that could lead to hemolytic transfusion reactions or ineffective transfusions.


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