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Factors associated with the severity of transfusion reactions that occurred in a teaching hospital, in the city of São Paulo, between 2007-2019

Fatores associados à gravidade das reações transfusionais ocorridas em hospital de ensino, na cidade de São Paulo, entre 2007-2019

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ABSTRACT

Introduction: Transfusion reactions can have serious consequences for recipients of blood components. Objective: To analyze the proportion of adverse reactions regarding the degree of severity observed in transfusions and to identify factors associated with the severity of immediate transfusion incidents. Method: This is a retrospective longitudinal study of epidemiological evaluation regarding the immediate transfusion reactions that occurred between 2007 and 2019 in a teaching hospital. Results: Of the 332,222 blood transfusions administered in the period, 1,448 notifications of immediate transfusion reactions were reported. The average annual incidence of transfusion reaction was 4.4 per thousand. Moderate and severe reactions represent 13.5% of all events. Hemoglobin and hematocrit did not present regular distribution ($p \leq 0.001$). Conclusion: The data analysis made it possible to evaluate the transfusion practice at the institution, which proved to be adequate and reflected the constant efforts to feed the Brazilian System of Hemovigilance. The severity of the reactions has been associated with inpatient units, which are more severe in the critical and semi-critical care units. However, the study showed that mild reactions should not be neglected.

KEYWORDS: Risk Management; Transfusion Reaction; Patient Safety; Blood Safety; Health Surveillance

RESUMO

Introdução: Reações transfusionais podem acarretar sérias consequências aos receptores de hemocomponentes. Objetivo: Analisar a proporção de reações adversas quanto ao grau de severidade observado nas transfusões de sangue e identificar os fatores associados à gravidade dos incidentes transfusionais imediatos. Método: Estudo longitudinal retrospectivo de avaliação epidemiológica das reações transfusionais imediatas ocorridas entre 2007-2019 em hospital de ensino. Resultados: Das 332.222 transfusões sanguíneas administradas, foram reportadas 1.448 notificações de reações transfusionais imediatas. A média de incidência de reação transfusional foi de 4,4 por mil/ano. As reações moderadas e graves representam 13,5% do total dos eventos. Hemoglobulina e hematócrito não apresentaram distribuição normal ($p \leq 0,001$). Conclusões: A análise dos dados possibilitou avaliar a prática transfusional na instituição, que se mostrou adequada, refletindo os constantes esforços para retroalimentar o Sistema Nacional de Hemovigilância. A gravidade das reações está associada à unidade de internação, sendo mais frequentes as graves nas unidades críticas e semicríticas, porém o estudo demonstrou que não se deve negligenciar as reações leves.

PALAVRAS-CHAVE: Gestão de Riscos; Reação Transfusional; Segurança do Paciente; Segurança do Sangue; Vigilância Sanitária

INTRODUCTION

Blood and blood component transfusions are therapeutic interventions that save lives and improve the health of patients, especially those who are hospitalized. Most transfusions provide the expected benefits of safe and effective replacement of blood components[1]. However, this procedure is not risk free. During transfusion, transmission of infectious agents and clinical complications caused by adverse events may occur[1,2]. The risk of transfusion reactions is estimated at 1:16,500, and the occurrence of deaths due to wrong indication of blood transfusion is around 1:500,000[3].

The most commonly administered blood component in clinical practice is packed red blood cells, indicated for the treatment of anemias[1,2,3,4]. Of the patients hospitalized in critical care units, it is estimated that about 70% have anemia and, of these, 25% will receive blood transfusion[5,6].

Hemoglobin (Hb), in g/dL, and hematocrit (Ht) values help in the conduct of hemotherapy. Low values of both Hb and Ht may indicate anemia. Transfusion of packed red blood cells is recommended in critically ill patients with Hb below 7 g/dL. Blood transfusion is not indicated when Hb is > 9.0 g/dL[7,8].

Several health professionals work to ensure the safety of this procedure. Transfusion agencies/blood banks check blood compatibility and perform immuno-hematological, pre- and post-transfusion tests to minimize risks and adverse reactions. Each health service may follow different protocols for the administration of hemotherapy, but it is recommended that the patient be monitored during the first 15 min of the infusion to observe signs and symptoms indicative of adverse events, such as tremors, cyanosis, urticariform reactions, chest or back pain, hypotension, shock, dark urine, tachycardia, and fever. The adverse effects of a transfusion are not always preventable and occur in 3% to 10% of procedures[2].

Transfusion reactions can be classified according to severity, as mild, moderate, severe, and sentinel event, and with the time of its onset, as immediate or late. Acute, life-threatening complications are rarer, while mild reactions are more common. Studies show that transfusion reactions reported to the Brazilian National Health Surveillance Agency (Anvisa) are mostly immediate mild reactions[1,4,5].

Immediate transfusion reactions are those that occur during or within 24 h after the installation of blood infusion. Its severity can vary widely during this period, although most high-severity and life-threatening reactions usually occur early in the administration of blood components[10]. It is estimated that the occurrence of deaths as a result of using an incorrectly transfused blood component is 1:500,000 as a consequence of immediate reactions[9].

The haemovigilance services that evaluate transfusion therapy aim to ensure patient safety, reducing errors in the prescription of blood components, improving the detection of adverse events and preventing their recurrence, in addition to contributing to the improvement of the quality of the blood cycle, considering the entire process that involves the donor and the recipient. However, statistics related to haemovigilance are not yet widely available in Brazil[11].

The haemovigilance services contribute with proposals for the implementation of preventive and corrective measures based on knowledge of the characteristics of patients and factors associated with adverse events. Risk management[5] in haemovigilance consists of establishing follow-up and monitoring strategies for blood transfusion to prevent the recurrence of adverse events and minimize the severity when they occur. Therefore, data related to haemovigilance support decision-making focused on risk management.

In this context and based on available data routinely collected in the haemovigilance service of a high-complexity university hospital, the present study aimed to analyze the immediate transfusion incidents, as to the degree of severity and proportion of adverse reactions observed in transfusions, and to identify factors associated with the severity of these incidents.

METHOD

Study design, period, and location

This is a retrospective longitudinal study of epidemiological assessment of immediate transfusion reactions that occurred between 2007 and 2019 in a high-complexity teaching hospital. With a philanthropic nature, the hospital has 862 beds, has been a member of the Brazilian Network of Sentinel Hospitals since 2002, located in the city of São Paulo (SP) and is a national and international reference for teaching and research. Data were collected through notification forms of transfusion reactions, received and stored in a Microsoft Excel database, by the Risk Management, from May 2007 to December 2019.

Population and sample

The study data were obtained from a total of 1,448 transfusion incident notification forms (TINF), used to feed the National Haemovigilance System (NHS), and maintained by the Blood Center and the Risk Management, which carry out the haemovigilance actions at Hospital São Paulo, University Hospital of the Federal University of São Paulo (Unifesp).

Inclusion criteria

All TINF of patients who received transfusion of blood and/or blood products, reporting an immediate transfusion incident for any reason, which contained, in the transfusion request, the duly recorded values of Hb and Ht.

Exclusion criteria

TINF with signs and symptoms not compatible with immediate transfusion reactions and those with a diagnosis of late reaction

were excluded. TINF with a diagnosis of probable or possible transfusion reaction were also not included in this study. TINF prior to 2007 were excluded, in which the research of values of Hb and Ht for annotation in the TINF by the Risk Management was not carried out.

Study protocol

The occurrence of transfusion incidents was registered in the TINF, prepared and validated by the institution itself to feed the Anvisa's NHS. The FNIT are part of the haemovigilance routine of the research institution. For the analysis of this study, the following TINF variables were used: date of birth, gender, date of transfusion, type of recipient (ABO system and Rh factor), hospitalization unit, Hb and Ht values, type of blood component administered and reported clinical manifestations, severity, and classification of the reaction. After confirmation of the diagnosis and classification of reactions by a hematologist at the institution's Blood Center, the TINF proceed to the Risk Management for inclusion in the institution's database and subsequent insertion in the NHS.

Notifications of transfusion incidents (or adverse reactions) followed the pattern established in the institution: after signs and/or symptoms compatible with transfusion incidents are identified, the infusion is interrupted and new blood samples are collected to be sent to the Transfusion Agency for immunohematological testing confirming the diagnosis of the reaction. The classification of transfusion incidents regarding diagnosis was confirmed by a hemotherapist physician, following Anvisa's recommendations published in 2015[2].

The pre-transfusional, Hb and Ht tests were performed in the Laboratory of Clinical Analysis of the Hospital São Paulo and followed the recommendations defined by the *Mayo Clinical Medical Laboratories*®, considering that the normality criteria for the Hb and Ht values are adjusted for sex and age. Thus, for over 16 years, the Hb values considered normal were 13.5-17.5 g/dL for men and 12.0-15, 5 g/dL for women; the Ht values were 39%-50% and 35%-45% for men and women, respectively. For children and adolescents up to 16 years of age, the normal Hb values range from 11.0-14.5 to 13.5-17.5 g/dL among boys and from 12.0-15.0 to 12.0-15.5 g/dL among girls; Ht values range from 33%-43% to 39%-50% for boys and 35%-44% to 35%-45% for girls.

Analysis of results

For data analysis, categorical variables were described by absolute and relative frequency. Numerical variables were described by measures of central tendency (mean and median) and variability (minimum, maximum, standard deviation, interquartile range) and examined for adherence to normal distribution using the Kolmogorov-Smirnov test. The association between independent categorical variables was studied using Pearson's x^2 test and between numerical and categorical variables using the Mann-Whitney test. In all tests, the established level of significance was 5%. To perform all analyses, the original data recorded in a Microsoft Excel® 2010 spreadsheet were imported into the SPSS® v statistical package. 22.

Ethical aspects

This study, after being inserted in Plataforma Brasil, was evaluated and approved under opinion Nº. 1794086 and Certificate of Presentation for Ethical Assessment (CAAE) Nº. 160855416.5.0000.5505, issued by the Research Ethics Committee of Unifesp, on October 26, 2016. This investigation meets the ethical precepts of Resolution Nº. 466, of December 12, 2012, of the National Health Council.

RESULTS

From a total of 1,663 TINF for all causes, 215 were excluded for not presenting the Hb and Ht values, leaving 1,448 records for analysis.

In the 13 years under study, from 2007 to 2019, 332,222 transfusions of blood and blood products were performed in the investigated institution, of which 1,448 had an immediate transfusion reaction, representing 4.4 per 1,000 transfusions on average per year. During this period, the number of transfusions per year ranged from 39,300 in 2014 to 18,016 in 2016, with an average of 25,560 transfusions/year (Table 1).

In the TINF verified, the proportion of men (51.2%) and women (48.9%) was similar, corresponding to 740 and 708 individuals, respectively (Table 2).

Regarding reporting units, the highest percentage of occurrences was registered in cancer patient units (35.7%) and the lowest in surgical and obstetric units (8.0%) (Table 2).

As for the type of blood component, the red blood cell concentrate corresponded to 72.3%, platelets to 21.3%, and the other blood components to 6.4% of the total of TINF (Table 2). At the institution studied, the total number of transfusions per concentrate of red blood cells in the period was close to 45.0% (data not shown).

Table 1. Absolute and relative frequency of immediate transfusion reactions and number of transfusions performed per year (n = 1448). Hospital São Paulo, 2007-2019.

Year	Immediate transfusion reactions		Blood component transfusions
	No.	%	Total (No.)
2007	127	5.3	23,926
2008	63	2.2	29,234
2009	88	3.5	25,130
2010	133	4.8	27,873
2011	104	3.3	31,179
2012	114	3.9	29,347
2013	132	4.0	33,173
2014	184	4.7	39,300
2015	124	4.7	26,504
2016	139	7.5	18,618
2017	68	2.7	24,304
2018	105	4.4	23,789
2019	135	5.5	24,249
Total	1,448	4.2	332,222

Source: Elaborated by the authors, 2019.

Regarding the ABO system and the Rh factor, the blood types $O^{(+)}$ and $A^{(+)}$ are the most frequent in TINF, with 43.5% and 31.8%, respectively. Among the least representative are groups $A^{(-)}$, with 1.2%, and groups $B^{(-)}$ and $AB^{(-)}$, with about 0.9% each of the total sample (Table 2).

The numerical variables age and Hb and Ht values were not normally distributed ($p < 0.001$). The median age observed was 45 years (interquartile range = 35), ranging from 0 (less than 1 year) to 94 completed years. The median value of Hb was 7.9 mg/dL (interquartile range = 2.1), with a minimum of 2.4 and a maximum of 17.6; values for Ht ranged from 7.7% to 52.3%, with a median of 23.5% (interquartile range = 5.8).

Table 3 presents data regarding the severity of transfusion reactions. It is verified that 86.5% of the TINF were classified as degree I of severity. Degree II and III accounted for 13.5% of the total. According to the classification of the transfusion reaction, the most common type diagnosed was the febrile non-hemolytic reaction (FNHTR), which represents 57.2% of the TINF, followed by the allergic reaction (ALG), with 37.5% of the total cases. In smaller proportions, circulatory overload (TACO) was observed, with 2.6%; acute immune hemolytic reaction (AIHR), with 1.2%, and the acute lung injury (TRALI), with about 1.0% of the reactions. With even less significant values, the following reactions were observed: transfusion-associated dyspnea (TAD), bacterial contamination (BC), and transfusion-related hypotension (HIPOT), totaling 0.5% of reported cases. The main signs and symptoms observed were skin lesions, with 27.3%, pruritus, with 26.9%, and tachycardia, with 16.9% of cases reported in the TINF. Hyperthermia (elevation of body temperature of at least 1°C) was reported in only 63 cases, representing 4.3% of the total TINF (Table 3).

Only the reporting unit showed a statistically significant association with the degree of severity, with critical and semi-critical units standing out in relation to the others, with a proportion of moderate/severe reactions equal to 13.5% ($p = 0.001$) (Table 4). The variables sex ($p = 0.847$), ABO system ($p = 0.646$), and Rh factor ($p = 0.852$) were not associated with the degree of severity by Pearson's x^2 tests.

Table 2. Characterization of transfusion incident notification forms (TINF) (n = 1.448). Hospital São Paulo, 2007-2019.

Variables		No.	%
Sex	Male	740	51.2
	Female	708	48.8
Inpatient unit	Oncology	517	35.7
	Medical clinics	249	17.2
	Urgency and emergency	229	15.8
	Critical and semi-critical	220	15.2
	Pediatric	118	8.1
	Surgical and obstetric	115	8.0
Blood components	Red blood cell concentrate	1,047	72.3
	Platelets	308	21.3
	Fresh plasma	91	6.2
	Hemoglobin/granulocytes	2	0.2
ABO/Rh Factor	A-	17	1.2
	A+	461	31.8
	B-	14	0.9
	B+	160	11.1
	AB-	13	0.9
	AB+	60	4.1
	O-	94	6.5
	O+	629	43.5
Hemoglobin	Below normal	1,411	97.5
	Normal	37	2.5
Hematocrit	Below normal	1.413	97.6
	Above normal	4	0.2
	Normal	31	2.2

Source: Elaborated by the authors, 2019.

Table 3. Classification of information present in transfusion incident notification forms (TINF) according to the severity and typology and signs and symptoms of transfusion reactions (n = 1448). Hospital São Paulo, 2007-2019.

		No.	%
Severity	Light (degree I)	1,253	86.5
	Moderate (degree II)	149	10.3
	Severe (degree III)	46	3.2
Type of reaction*	Febrile non-hemolytic (FNHTR)	828	57.2
	Allergic (ALG)	543	37.5
	Circulatory overload (TACO)	38	2.6
	Acute immune hemolytic (AIHR)	15	1.2
	Acute lung injury (TRALI)	12	1.0
	Transfusion-associated dyspnea (TAD)	3	0.2
	Bacterial contamination (BC)	2	0.2
	Transfusion-related hypotension (HIPOT)	1	0.1
	Chills	399	33.0
Signs and Symptoms	Chills	399	27.5
	Skin lesions	396	27.3
	Pruritus	390	26.9
	Tachycardia	245	16.9
	Dyspnea	183	12.6
	Temperature rise => 1°C	63	4.3
	Change in blood pressure	55	3.8
	Chest pain	35	2.7
	Cyanosis	31	2.5
	Back pain	25	2.1
	Jaundice	9	0.6
	Hematuria	4	0.2
	Hypertension	4	0.3
	Others	73	5.0

Source: Elaborated by the authors, 2019.
*In each TINF, more than one sign or symptom may be reported.

Table 4. Distribution of information present in transfusion incident notification forms (TINF) such as gender, ABO system, Rh factor, and occurrence unit according to the severity of transfusion reactions (n = 1,448). Hospital São Paulo, 2007-2019.

		Severity (degree)*				Total		$x^{2\ test}$
		I		II and III				
		No.	%	No.	%	No.	%	
Sex	Female	639	86.6	101	13.6	740	100.0	p = 0.847
	Male	615	86.7	94	13.3	708	100.0	
ABO	A	419	87.7	59	12.3	478	100.0	p = 0.646
	B	146	83.9	28	16.1	174	100.0	
	AB	60	82.2	13	17.8	73	100.0	
	O	626	86.6	97	13.4	723	100.0	
Rh factor	Negative	120	87.0	18	13.0	138	100.0	p = 0.852
	Positive	1,131	86.3	179	13.7	1,310	100.0	
	Surgical and obstetric	101	87.8	14	12.2	115	100.0	
Inpatient unit	Medical clinics	217	87.2	32	12.8	249	100.0	p = 0.001
	Critical and semi-critical	167	76.0	53	24.0	220	100.0	
	Oncology	463	89.7	54	10.3	517	100.0	
	Pediatric	101	85.6	17	14.4	118	100.0	
	Urgency and emergency	201	88.1	28	11.9	229	100.0	
Total		1,250	85.7	198	14.3	1,448	100.0	

Source: Elaborated by the authors, 2019.
*Degree I = light; II = moderate; III = severe.

Table 5. Distribution of the information present in the transfusion incident notification forms (TINF) such as age (years), hemoglobin values (mg/dl), and hematocrit (%) according to the severity of transfusion reactions (n = 1,448). Hospital São Paulo, 2007-2019.

Severity**	Age (years)*		Hemoglobin (mg/dl)*		Hematocrit (%)*	
	I	II and III	I	II and III	I	II and III
N	1,045	163	1,045	163	1,045	163
Average	42.9	48.6	8.1	8.2	24.0	24.6
Median	43.0	51.0	7.9	7.9	23.4	23.7
Standard deviation	20.95	24.57	1.74	1.99	5.19	5.97
Minimum	0.0	0.0	2.4	3.4	7.7	9.7
Maximum	94.0	93.0	17.6	15.0	52.3	43.7
Interquartile range	34.0	40.0	2.1	2.0	5.7	6.0
Mann-Withney test	p = 0.003		p = 0.470		p = 0.453	

Source: Elaborated by the authors, 2019.
* Variables did not show normal distribution by the Kolmogorov-Smirnov test.
** Degree I = light; II = moderate; III = severe.

Comparing the age and the Hb and Ht values in the two groups of mild and moderate/severe degree of severity of the FNIT, the median values of Hb and Ht were similar in both groups, while the median age of the group with mild reaction (43 years) was lower than in the group with moderate or severe reaction (51 years), with p = 0.003 (Table 5).

DISCUSSION

In this study, we analyzed the TINF that occurred and were routinely reported to Anvisa, in the last 13 years, in a high complexity teaching hospital. From 2007 to 2019, 1,448 TINF were examined out of a total of 1,663 immediate reactions, referring to 332,222 transfusions of blood and derivatives, performed in the investigated institution. In the state of São Paulo, in 2016, immediate incidents represented 99% of total transfusion reactions reported to the Health Surveillance Center (HSC)[12].

The annual incidence rate found in the present study, 4.4 reactions per 1,000 transfusions, was lower than that found in the Hospital de Clínicas in Uruguay, where the rate was 8.3 per 1,000 blood components administered[13]. Lower rates were found with values of 1.7 in northern Minas Gerais[14] and 3.9 per 1,000 blood transfusions in northern Paraná[15]. Other studies outside Brazil reported annual incidence rates of adverse reactions between 0.2 and 7.7 per 1,000 blood components infused[10,16,17]. Such values may vary according to the strategies adopted in each service for haemovigilance, such as active or passive search[17].

In the TINF analyzed, the proportion of men (51.2%) and women (48.9%) recipients of blood and blood components was similar, data

corroborated by other studies[6,18,19]. The median age of 45 years (0-94 years) was similar to the mean age of patients who had transfusion reactions in a hospital in Northeastern Brazil (mean age 48), which also included pediatric patients. Another publication that did not include pediatric patients had higher mean age, from 55 to 61 years[5,20,21]. The median age found in this analysis is within the age group in which there was the highest frequency of transfusion reactions in the state of São Paulo (30 to 70 years or more)[12].

Regarding the blood type of the recipients identified in the TINF, the types $O^{(+)}$ and $A^{(+)}$ are the most frequent, with proportions around 43.0% and 32.0%, respectively. These proportions are similar to those of blood donors in Brazil, which, in 2015, corresponded to 43.0% for the $O^{(+)}$ group and 30.3 % for $A^{(+)}$[22].

Based on the Hb and Ht values, it can be said that the transfusion practice in the researched institution is in accordance with the recommended guidelines, since 97.5% of transfusions occurred in patients with values below normal reference parameters. In a Brazilian study that analyzed transfusions in critically ill patients from different intensive care units, in which half of the indications for transfusion occurred due to low Hb and 32.0% due to active bleeding, the transfusion practice was considered partially adequate[8]. The lower limit of the normal reference values for the Hb concentration in the blood has been the object of research by North American authors concerned with the diagnosis and prevalence of anemia[23].

Oncology inpatient units represented 37.5% of the total TINF analyzed. As for the use of the blood component, 72.3% of the reactions occurred with the administration of packed red blood cells, which is the blood product commonly used in clinical practice[1,5,6,24]; data slightly lower than that observed in the state of São Paulo between the years 2012 and 2015, in which 3,384,818 (56.0%) of red blood cell concentrates were performed from a total of 6,045,102 transfusions. The fact that 72.2% of the immediate reactions in the studied institution occurred through transfusion of packed red blood cells is indicative of the association between this component and immediate transfusion incidents. Fatal reactions were not analyzed during the period of this study.

According to the results presented, the proportion of more severe immediate adverse reactions (degree II and III) was 13.5%. Such reactions represent a potential risk of death for the patient[18]. In a study carried out in the city of Havana, Cuba, with 3,347 blood transfusions and 40 transfusion reactions, the authors found 8.0% of severe reactions with two deaths, both reported in an intensive care unit[25].

In the TINF analyzed, the most common reactions were febrile non-hemolytic reaction (57.2%) and allergic reaction (37.5%), similar to data reported in two other national studies[10,24]. In an investigation conducted in Uruguay[13] with 58 transfusion reactions, the authors evidenced seven (12%) reactions of severe severity (degree I) and two that resulted in the patients' death.

The main signs and symptoms reported in the TINF were; chills (27.5%), skin lesions (27.3%), pruritus (26.9%), and tachycardia (16.9%). Hyperthermia with an elevation of at least 1°C in body temperature was reported in 4.3% of reactions, findings consistent with the literature[1,5,6]. The main clinical manifestations were urticaria (40.4%) and chills (20.2%)[1]. In Japan[19], among the most severe reactions, the authors reported signs and symptoms compatible with an allergic reaction, such as itching and skin lesions.

Among the variables studied, gender, ABO system, Rh factor, and Hb and Ht values were not associated with the severity of immediate transfusion reactions. Only age ($p = 0.003$) and unit of occurrence ($p = 0.001$) were statistically significant by Pearson's x^2 test. Patients with more severe reactions were older, and the proportion of moderate/severe reactions was higher (24.0%) in critical and semi-critical units. In two other studies, the first conducted in Iran, there was no association between age and the occurrence of transfusion reactions[18], and the second carried out in Cuba, there was no mild reaction in intensive/critical care units, with 8.0% of reactions considered severe[25].

CONCLUSIONS

The analysis of the data routinely collected at the institution made it possible to assess the transfusion practice, which proved to be quite adequate, reflecting the constant efforts to identify and report transfusion incidents. The results showed as risk factors patients aged 50 or more hospitalized in critical and semi-critical units with chronic diseases or cancer, undergoing transfusion therapy, in order to prevent complications related to these procedures. Regarding severity, there is a higher frequency of severe and moderate reactions in critical units, however the health teams cannot neglect to take care of mild reactions that occur in other units.

By evaluating a large amount of blood transfusions per year, this study may contribute to support haemovigilance actions in Brazil, which are still incipient.

Despite efforts to monitor, investigate, and report adverse reactions related to blood transfusions, there may still be underreporting of these events in the research institution, as well as in other Brazilian hemotherapy services. It was not possible to investigate the morbidity and mortality of transfusion reactions with follow-up of patients exposed to blood transfusion. Thus, new approaches are suggested to assess the risk factors associated with blood transfusions.

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Author's Contributions

Grandi JL - Conception, planning (study design), analysis, data interpretation, and writing of the work. Chiba A, Oliveira MMB, Areco KCN - Data acquisition, analysis, and interpretation. Barbosa DA - Writing of the work. All authors approved the final version of the work.

Conflict of Interests

The authors inform that there is no potential conflict of interest with peers and institutions, politicians, or financial in this study.