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Comprehensive Evaluation of Blood Product Transfusions Administered in the Emergency Department

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Abstract

Objective: It was aimed to evaluate the clinical and laboratory findings, the frequency and distribution of post-transfusion complications of patients who presented to the emergency department with a transfusion indication.

Materials and Methods: In our study, patients aged 18 years and over who applied to the emergency medicine clinic between January 01, 2019 and March 31, 2019, who had blood and blood product transfusions, were retrospectively analyzed. The demographic and clinical characteristics of the patients, the reason for transfusion, the number of transfused blood products, the presence and type of complications were analyzed.

Results: Three hundred and sixty-eight patients who received blood and blood product transfusions were included in the study. The mean age of the patients was 62.5±19.3 years (range 18-96 years), 193 (52.4%) were female and 175 (47.6%) were male. The most common causes of transfusion were symptomatic anemia in 110 patients (29.9%), oncological diseases in 71 patients (19.3%), gastrointestinal bleeding in 65 patients (17.7%), and chronic renal failure patients in 59 (16%) patients. No post-transfusion complication was observed in 358 (97.3%) patients for all blood products. Multiple erythrocyte suspension (ES) data revealed significant variation in hemoglobin and hematocrit levels among patients (p=0.001). Additionally, a significant difference was found in the international normalized ratio because of administering more than one unit of fresh frozen plasma (FFP) (p=0.002). Complications were observed in 2.9% of patients given ES and 1.9% of patients given FFP, whereas none of the patients given thrombocyte suspension developed.

Conclusion: The appropriate use of blood and blood products in the emergency department plays a critical role in preventing patient morbidity and mortality. Performing the transfusion procedure in the correct indication is important in preventing the risk of infection in the emergency department.

Keywords: Blood transfusion, red blood cells, blood product, hemoglobin, emergency department

Introduction

Blood and blood product transfusions, which play an important role in critical patient care, are used in the emergency department as a treatment option for trauma and acute blood loss. On the basis of symptoms and clinical examination, the correct identification of patients with a high priority for blood transfusion and estimation of blood volume for transfusion are often performed. However, giving each blood unit incurs costs for the healthcare system, and these products must be transfused quickly. Hence, accurate prognosis and identification of patients' blood transfusion requirements must be considered as well [1]. Blood and blood products are living tissues made up of various structures, each serving a different purposes. Blood transfusion is a life-saving procedure that is similar to tissue transplantation and carries some risks [2].

Blood and blood product transfusions are frequently performed in emergency departments where many patients come for treatment and diagnosis [2]. Approximately 15 million units

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of erythrocyte suspension (ES) are transfused annually in the United States, and this figure is 85 million units worldwide [3]. In line with the recommendations in the guidelines for blood transfusion, lower values for ES transfusion were determined for critically ill patients in conditions such as intensive care and onco-hematology [4]. While a threshold of 7 g/dL is given for the hemoglobin (Hb) value, especially for patients with acute gastrointestinal (GI) bleeding, the lower limit of Hb value is 10 g/dL in cases of acute coronary syndrome or heart failure or in a patient with symptomatic anemia describing tachycardia, mental status change, hypotension, and dyspnea. recommended as dL [5,6]. Apart from these conditions, the threshold value may vary according to the tolerance status of the patient in patients who receive chemotherapy, are anemic due to chronic conditions, or have hematological malignancies [7].

Transfusion of blood and blood products is a transplantation process for living tissues that might result in life-threatening problems such as allergic reaction and volume overload [8]. There is a need in the literature for research on the outcomes of transfusions and the frequency of complications. Research focusing on the transfusion of blood and blood products, particularly in emergency services, is crucial for developing acute transfusion requirement algorithms.

This study aimed to increase awareness in the operation of the emergency service by examining the clinical circumstances and laboratory findings of patients in the emergency department, which form the transfusion indication. Therefore, it will be possible to evaluate the correct indication for blood transfusion in the emergency room and to provide the appropriate intervention by anticipating potential complications.

Materials and Methods

Study Design and Population

The study sample comprises 368 patients 18 years and older who received blood and blood product transfusions in the emergency department of our hospital between January 1, 2019 and March 31, 2019. The patient information was extracted from the computerized recording system. It is a hospital for tertiary education and research with comprehensive computer data security. Participants with missing data in the electronic registration system were excluded from the study, whereas patients who underwent transfusions of blood and blood products were included.

Before starting the study, permission was obtained from the Clinical Research Ethics Committee of University of Health Sciences Turkey, İstanbul Bağcılar Training and Research Hospital (date: 15.01.2021, number: 2021.01.1.1.09.208. r1.009). In the conduct of the study, the Declaration of Helsinki and the principles of Good Clinical Practice were followed. The data of the patients included in the study were not used other than for scientific purposes. No financial support was received from any person or organization at any stage of the research, including design, data collection, data analysis, and writing.

Patient data were obtained by retrospectively scanning patient files. During the screening, a case report form was used. The case report form includes 16 variables of patients' demographic and clinical characteristics and transfusion-related characteristics. These variables are age, gender, triage level (yellow, green, and red areas), blood group, reason for transfusion, pre-transfusion and post-transfusion Hb, hematocrit (Hct), international normalized ratio (INR) values and platelet count, transfused blood product ES, fresh frozen plasma (FFP), thrombocyte suspension (TS), and whole blood, number of blood products [unit (U)], the presence of complications, type of complication, and outcome of patients (outpatient treatment, hospitalization, intensive care admission, emergency surgical operation, exitus).

Statistical Analysis

SPSS version 22.0 statistical software was used in the analysis of the data. The socio-demographic characteristics, clinical characteristics, and descriptive statistics of the transfusion-related characteristics of the patients included in the study are given. The descriptive statistics of the study are shown using mean ± standard deviation and median, minimum, and maximum values for numerical variables, and numbers (n) and percentage (%) for categorical variables. For continuous numerical variables that did not show a normal distribution, the Mann-Whitney U test was used for comparisons of two groups, and the Kruskal-Wallis test was used for comparisons of more than two groups. Dunn's post-hoc test was used for post-hoc pairwise comparisons. Fisher's exact test was used to compare categorical variables. The statistical significance limit was accepted as $p<0.05$.

Results

The mean age of the patients was 62.5±19.3 years (range 18-96 years), 193 (52.4%) were female and 175 (47.6%) were male. When the triage levels were examined, 138 patients (37.5%) were observed in the green area, 140 patients (38.0%) were in the yellow area, and 90 patients (24.5%) were in the red area. According to the blood groups, the blood group of 20 (5.4%) patients were 0 Rh (-), 110 (29.9%) 0 Rh (+), 24 (6.5%) A Rh (-), 134 (36.4% A Rh (+), 10 (2.7%) B Rh (-), 54 (14.7%) B Rh (+), and 16 (4.3%) AB Rh (+) were determined (Table 1).

Common causes of blood transfusion were symptomatic anemia in 29.9%, oncological disease in 19.3%, GI hemorrhage in 17.7%, and chronic renal failure (CRF) in 16.0%. Other causes included warfarin overuse, non-traumatic hemorrhage, traumatic hemorrhage, and hematological diseases. The mean

Hb value before transfusion of the patients participating in the study was 6.98±1.95 g/dL, the mean Hct value was 22.78±5.74 (%), the mean platelet count was 268635±163300 cells/μL, and the mean INR was 1.89±2.50. Post-transfusion complications were not observed in 358 (97.3%) patients, whereas 5 (1.4%) had fever, 4 (1.1%) urticaria, and 1 (0.3%) volume overload. Of the patients, 204 (55.4%) were followed-up outpatients, 134 (36.4%) were hospitalized, 18 (4.9%) were hospitalized in the intensive care unit, 10 (2.7%) had emergency surgery, and 2 (0.5%) resulted in mortality (Table 1).

Table 1. Demographic and clinical characteristics of patients transfused with blood and blood products

Demographic and clinical characteristics		n (%)
Gender	Female	193 (52.4)
	Male	175 (47.6)
Age (year)	<40	55 (14.9)
	40-59	88 (23.9)
	60-79	145 (39.4)
	>80	80 (21.7)
Mean ± SD (age/year)	62.5±19.3	
Application area	Green	138 (37.5)
	Yellow	140 (38.0)
	Red	90 (24.5)
Blood group	0 Rh (-)	20 (5.4)
	0 Rh (+)	110 (29.9)
	A Rh (-)	24 (6.5)
	A Rh (+)	134 (36.4)
	B Rh (-)	10 (2.7)
	B Rh (+)	54 (14.7)
	AB Rh (+)	16 (4.3)
Transfusion reason	Symptomatic anemia	110 (29.9)
	Oncological disease	71 (19.3)
	Gastrointestinal hemorrhage	65 (17.7)
	Chronic renal disease	59 (16.0)
	Warfarin overuse	23 (6.3)
	Non-traumatic hemorrhage	17 (4.6)
	Traumatic hemorrhage	12(3.3)
	Hematological disease*	11 (3.0)
Post-transfusion complication	None	358 (97.3)
	Fever	5 (1.4)
	Urticaria	4 (1.1)
	Volume load	1 (0.3)
Clinical outcome	Outpatient treatment	204 (55.4)
	Inpatient service	134 (36.4)
	Intensive care unit	18 (4.9)
	Emergency surgery	10 (2.7)
	Mortality	2 (0.5)
Total		368 (100)

Distribution of variables as n (%), *Thrombotic thrombocytopenic purpura, immune thrombocytopenic purpura, myelodiplastic syndrome, thalassemia etc. includes diseases, SD: Standard deviation

When the distribution of ES transfusion was analyzed according to the triage level and transfusion reasons, the mean ES given to the patients admitted to the green area was 1.56±0.77 U, 1.71±0.96 U in the yellow area, and 1.83±0.89 U in the red area. This difference between the groups was not statistically significant (p=0.070). Among the causes of transfusion, GI hemorrhage was the most common cause of ES transfusion, whereas hematological diseases, oncological diseases, traumatic hemorrhages, and warfarin overuse were other causes. There was a significant difference between the reasons for ES transfusion administration (p=0.001). Considering the distribution of FFP in transfusion rates, the mean FFP given to patients admitted to the green area was 0.14±0.49 U, 0.20±0.53 U in the yellow area, and 0.36±0.74U in the red area (p=0.016). Warfarin overuse was found to be the most common cause of 1.87±0.55 U among the causes of FFP transfusion (p=0.001). When the TS transfusion distribution of the patients was examined, the mean TS given to the patients applied in the green area was 0.03±0.21 U, 0.07±0.33 U in the yellow area, and it was found that no TS was given to the patients who applied to the red area. This difference between the groups was not statistically significant (p=0.066). Among the causes of TS transfusion, hematological diseases were the most common cause (p=0.001, Table 2).

Hb changes after transfusion in patients who received ES transfusion mean Hb change in patients who received 1U ES was 1.16±0.64 g/dL, 2.20±0.93 g/dL in patients who received 2U, 2.99±1.23 g/dL in patients who received 3U. It was determined as 3.08±1.34 g/dL in those given 4U, and 5.80 g/dL in those given 5U. (p=0.001). In post-hoc pairwise comparisons of post-transfusion Hb changes in patients who received ES transfusion, there was a statistically significant difference between patients given 1U ES and patients given 2U (p=0.001) and between patients given 2U of ES and patients given 3U (p=0.014) in terms of Hb exchange levels. However, there was no statistically significant difference in Hb change between patients given 3U and patients given 4U, and between patients given 4U and patient given 5U (Figure 1).

When the post-transfusion Hct changes according to the number of transfusions were examined, the mean Hct change was 3.81±2.69% in patients given 1U ES, 6.50±3.41% in patients given 2U, 8.71±3.81% in patients given 3U. While it was 8.53±4.19% in those given 4U, the change in Hct was found to be 17.30% in 1 patient who was given 5U (p=0.001). Post-Hoc paired comparisons of Hct changes after transfusion in patients who received ES transfusion found a statistically significant difference in terms of Hct change levels between

patients given 1U ES and patients given 2U (p=0.001), and patients given 2U ES and patients given 3U (p=0.016). However, there was no statistically significant difference between the patients given 3U and the patients given 4U, and between the patients given 4U and the patient given 5U in terms of Hct change (Figure 2).

Discussion

Changes in environmental conditions in modern life, an increase in the number of patients in emergency services, and the appearance of new types of diseases increase the demand for blood, for which there is no substitute [9]. Blood and its derivatives derived from humans are expensive and difficult to obtain; therefore, it is vital to handle these products with more care and avoid their unnecessary use [10,11]. In this study, we studied the indications, therapeutic applications, and problems of blood and its products, which are commonly used by emergency services.

Because of several clinical investigations, blood and its products are used differently based on gender. 61% of the 507 patients who received blood transfusions in the study by Waiswa et al. [12] were male, whereas 39% were female. In the study by Okello et al. [13] on patients aged 28 to 54 years, 55% of the transfused patients in 2012 were female. According to the literature, 175 (46.6%) of 368 patients in our study were male.

When the blood group distributions of the transfused patients were examined, the blood groups of the transfused patients were examined and it was found that 41.4% were group A, 36% were group O, 15.4% were group B, and 7.2% were group AB [14]. In the blood transfusion study by Azizi et al. [15], it was determined that 28.6% group A, 34.3% group O, 14.3% group B,

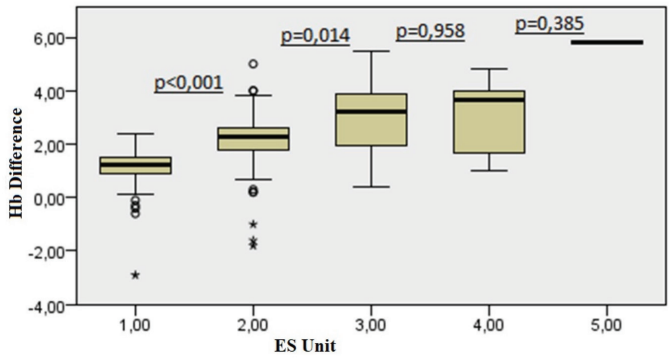

Figure 1. Post-transfusion Hb changes according to the number of transfusions in patients who received ES transfusion

HB: Hemoglobin, ES: Erythrocyte suspension

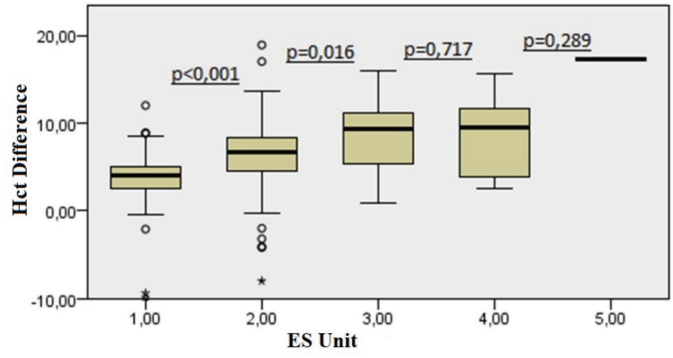

Figure 2. Post-transfusion Hct changes according to the number of transfusions in ES transfused patients

HCT: Hematocrit, ES: Erythrocyte suspension

Table 2. Distribution of ES, FFP and TS transfusions according to patients' application area and transfusion reasons

		Erythrocyte suspension unit		Fresh frozen plasma unit		Thrombocyte suspension unit	
		Mean ± SD	p value	Mean ± SD	p value	Mean ± SD	p value
Triage level	Green	1.56±0.77	0.070	0.14±0.49	**0.016**	0.03±0.21	0.066
	Yellow	1.71±0.96		0.20±0.53		0.07±0.33	
	Red	1.83±0.89		0.36±0.74		0	
Transfusion reason	Symptomatic anemia	1.65±0.60	**0.001**	0.04±0.19	**0.001**	0.00±0.00	**0.001**
	Oncological disease	1.70±0.72		0.11±0.32		0.08±0.33	
	Gastrointestinal hemorrhage	2.20±1.02		0.12±0.38		0.02±0.12	
	Chronic renal disease	1.64±0.76		0.03±0.18		0	
	Warfarin overuse	0.57±1.12		1.87±0.55		0	
	Non-traumatic hemorrhage	1.41±0.71		0.59±0.87		0	
	Traumatic hemorrhage	1.67±0.49		0.33±0.89		0	
	Hematological disease*	1.82±1.47		0		0.64±0.92	
Total		1.68±0.88		0.21±0.58		0.04±0.24	

Chi-square test was used (p<0.05 significance level), *Thrombotic thrombocytopenic purpura, immune thrombocytopenic purpura, myelodiplastic syndrome, thalassemia etc. includes diseases. ES: Erythrocyte suspension, FFP: Fresh frozen plasma, TS: Thrombocyte suspension, SD: Standard deviation

and 14.3% group AB patient. In 8.6 percent of the patients, the blood group was not determined. In our study, we think that the patients with excess blood groups 0 and A are the patient group that receives the most transfusions because it is the most common blood group in the community.

The most prevalent reasons for transfusion were symptomatic anemia, cancer, GI bleeding, and CRF. In comparable research, gastroenterological (34%), oncological (19%), and hematooncological (13%) causes have been identified [16-18].

The transfusion of blood and its products is inevitably fraught with difficulties. During the transfusion of blood components, allergic responses are prevalent, and the clinical severity of these reactions varies [18]. In the study by Hatayama et al. [19], the incidence of blood transfusion reactions was determined to be 2.6% throughout 11,423 infusions. In the study by Sarkodee-Adoo et al. [20] examining the association between the development of transfusion responses and platelet storage time, 0.26% of patients who received TS transfusions exhibited an allergic reaction. The study by Heddle et al. [21] also revealed that 4.8% of patients receiving TS transfusions experienced an adverse reaction. In our study, problems were not seen in 97.3% of patients, whereas 1.4% of patients experienced fever, 1.1% urticaria, and 0.3% volume overload. We believe that, despite the similarity of the conditions, our hospital's expertise and experience allow us to observe complications at an acceptable rate.

Studies have also found that severe organ failure and high mortality rates were observed in patients who underwent transfusion [22]. In a study by Rao et al. [23] on patients who received multiple transfusions in intensive care units, they showed that the frequency of mortality increased with transfusion. In the study by Leal-Noval et al. [24] with patients with similar age, Acute Physiology and Chronic Health Evaluation-II and Sequential Organ Failure Assessment scores, diagnosis, and Hb values, and patients who did not receive transfusion and those who received transfusion. found higher mortality rates in patients who were treated. In a randomized pilot study by Walsh et al. [25], free and restrictive transfusion strategies were compared in patients aged 55 years and older and receiving mechanical ventilation for more than four days. In a comparison of mortality and length of stay in the intensive care unit between patients who received free transfusion Hb below 9 g/dL and those who received restrictive transfusion Hb below 7 g/dL, those who received free transfusion had higher death rates [25]. Two (0.5%) of the 368 patients who received blood and blood products died in our study. Patients with mortality had Hb below 7g/dL and had active bleeding. We believe that mortality is mostly related to the serious clinical condition of the patients and not due to transfusion.

In research including 61 cancer patients, Mercadante et al. [26] reported that the median Hb value before the transfusion was 8 g/dL. In our investigation, this value was shown to be more than the usual Hb value. In this study, we assessed the degree of change in Hb, Hct, platelet count, and INR values before and after transfusion. The average pre-transfusion Hb level of the patients in our study was 6.98±1.95 g/dL, and the Hct level was 22.78±5.74%. The low mean values of Hb and Hct observed in our study are due to active bleeding. The values in the service and intensive care units were found to be somewhat higher due to the intervention of active bleeding by emergency services personnel and the transfusion of blood and blood products.

When the Hb value of patients falls below 8 g/dL in general, ES transfusion is frequently performed at higher levels in surgical patients [13,16]. In the CRIT study, it was shown that 45% of the patients received 5U or more ES transfusions, an average of 4.6±4.9U ES was given, and the amount of blood transfused and clinical survival were independent factors [27]. In the study by Fuller et al. [28], they included 93 patients diagnosed with septic shock and divided the patients into two groups as non-transfused and administered, and it was found that an average of 4.56U blood transfusion was administered to 43 patients who received blood transfusion. In the study by Shapiro et al. [18], it was shown that an average of 5.8±5.5 units of ES was given to trauma patients followed in the intensive care unit and that a large amount of transfusion was needed. In our study, it was observed that 342 patients were given ES in a 90-day follow-up. In our hospital, blood transfusion is targeted for patients with an average Hb value below 7 g/dL. When the effect of ES and the number of units given to the patients on the increase in Hb and Hct were examined, a significant change was detected up to the first 3U. However, no significant change was detected in patients who received ES transfusion over 3U. Additionally, the risk of complications was found to be the same among ES transfusions given more than once.

Patients who are followed-up by emergency services and whose blood and products are transfused various rates of hospitalization, referral to a better-equipped hospital, and discharge. In some studies, 1.6% of patients who underwent blood and product transfusions in the emergency department were referred to another health institution, discharged, or died in the emergency department [29,30]. In our study, 204 patients (55.4%) were discharged, 134 (36.4%) were transferred to the service, 18 to the intensive care unit, and 10 (2.7%) underwent emergency surgery. We did not refer any of our patients to an external center. Again, we attribute this to the fact that our hospital has a professional, tertiary-level transfusion program.

Study Limitations

Our study has some limitations. The most important of these is that it is applied in a single center and on a limited patient

population, and it is retrospective. Additionally, additional diseases of the patients, the drugs they used, and the short follow-up period are other important reasons for restriction.

Conclusion

It is obvious that blood transfusions have a life-saving effect, but it is clear that there are also risks of transfusion-related complications. Additionally, we believe that clinical decision-makers for blood and blood product transfusions will benefit patients by determining the volume of transfusion and blood product to be supplied, as well as assessing the possibility of complications. There is a need for prospective, randomized, and controlled multicenter trials in a broader population.

Ethics

Ethics Committee Approval: Clinical Research Ethics Committee of University of Health Sciences Turkey, İstanbul Bağcılar Training and Research Hospital (date: 15.01.2021, number: 2021.01.1.1.09.208.r1.009).

Informed Consent: Required informed consent was provided.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: S.S., A.C., B.D., B.Ç., Design: S.S., A.C., B.D., B.Ç., Data Collection or Processing: S.S., A.C., B.D., B.Ç., Analysis or Interpretation: S.S., A.C., B.D., B.Ç., Literature Search: S.S., A.C., B.D., B.Ç., Writing: S.S., A.C., B.D., B.Ç.

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