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Evaluation of Blood Product Requests in the Emergency Department: A Prospective Observational Study

Acil Serviste Kan Ürünü İstemlerinin Değerlendirilmesi: Prospektif Gözlemsel Bir Çalışma

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Evaluation of Blood Product Requests in the Emergency Department: A Prospective Observational Study

ABSTRACT

Objective: Emergency department (ED) blood product requests are rising, but it is unclear if they are excessive. We aimed to examine the blood product requests and usage rates made by emergency physicians to determine whether the requests for blood products are excessive.

Material and Method: This prospective, observational, and single-center study analyzed demographic data indications for blood transfusion, and transfusion rates of patients aged 18 years and older admitted to a tertiary adult emergency department in five months.

Results: One thousand four hundred seventy-five blood product requests (with a mean of 6.92 units per patient) were examined. Of 63.1%, these requests were not used. The transfusion rates were 40.89 % for erythrocyte suspension, 25.61% for thrombocyte suspension, and 44.34% for fresh frozen plasma. The main indications for requesting blood products were gastrointestinal bleeding and anemia. Specifically, 30.04% of erythrocyte suspensions, 31.9% of thrombocyte suspensions, and 60.56% of fresh frozen plasma were used for patients with gastrointestinal bleeding. In trauma patients, 12.75% of requested erythrocyte suspensions, 0.083% of thrombocyte suspensions, and 13.89% of fresh frozen plasma were utilized.

Conclusion: Excessive requests for blood products in the emergency department can misuse resources. The transfusion committee should develop specialized strategies and increase physician awareness to reduce unnecessary requests and optimize resource utilization.

Keywords: Erythrocyte suspension, blood products, fresh frozen plasma, resource utilization, transfusion, thrombocyte suspension.

ÖZET

Amaç: Acil servis kan ürünü istemleri artıyor, ancak aşırı olup olmadığı belirsizdir. Acil hekimleri tarafından yapılan kan ürünü istemlerini ve kullanım oranlarını inceleyerek kan ürünleri istemlerinin aşırı olup olmadığını tespit etmeyi amaçladık.

Gereç ve Yöntem: Bu prospektif, gözlemsel ve tek merkezli çalışma, beş ay içinde üçüncü basamak bir yetişkin acil servisine başvuran 18 yaş ve üzeri hastaların demografik verilerini, kan transfüzyonu endikasyonlarını ve transfüzyon oranlarını incelemiştir.

Bulgular: Bin dört yüz yetmiş beş kan ürünü istemi (hasta başına ortalama 6,92 ünite) incelendi. Bu istemlerin %63,1'i kullanılmadı. Transfüzyon oranları eritrosit süspansiyonu için %40,89, trombosit süspansiyonu için %25,61 ve taze donmuş plazma için %44,34 idi. Kan ürünleri istemenin ana endikasyonları gastrointestinal kanama ve anemiydi. Gastrointestinal kanaması olan hastalarda spesifik olarak eritrosit süspansiyonlarının %30,04'ü, trombosit süspansiyonlarının %31,9'u ve taze donmuş plazmaların %60,56'sı kullanıldı. Travma hastalarında istenen eritrosit süspansiyonlarının %12,75'i, trombosit süspansiyonlarının %0,083'ü ve taze donmuş plazmaların %13,89'u kullanıldı.

Sonuç: Acil serviste kan ürünlerine yönelik aşırı istemler, kaynakların yanlış kullanılmasına neden olabilir. Transfüzyon komitesi, gereksiz istekleri azaltmak ve kaynak kullanımını optimize etmek için özel stratejiler geliştirmeli ve hekim farkındalığını arttırmalıdır.

Anahtar Sözcükler: Eritrosit süspansiyonu, kan ürünleri, kaynak kullanımı, taze donmuş plazma, transfüzyon, trombosit süspansiyonu.

Introduction

In recent years, blood transfusions in the emergency department (ED) have increased significantly compared to other clinical departments (1). This situation reveals the necessity of plans for blood transfusion management in EDs, which are the first responders to the preventable deaths due to bleeding.

The availability of blood products relies on continuous donations from the public. The blood donation rate required to meet basic blood needs is considered to be 1% of the country's population, but more than 70 countries worldwide cannot reach this rate (2). Globally, approximately 85 million units of erythrocyte suspensions (ESs) are transfused each year. Studies have indicated that 5-58% of blood products are transfused unnecessarily or inappropriately (1). Insufficient volunteer blood donors and inadequate storage conditions pose significant challenges. Furthermore, the tendency of physicians to routinely request large amounts of blood leads to a range of problems, including excess reserved blood after cross-matching, inventory issues, loss of shelf life, increased costs, and wastage of blood products (1,2).

There is limited data regarding the extent of blood product overuse in the ED. This study aims to determine the factors influencing the need for blood transfusion in ED patients and to identify usage rates of blood products requested from the ED, with the aim of reducing unnecessary requests.

Material and Methods

Study Design and Setting

This study was designed as a prospective-observational single-center study. The patients 18 or older admitted to a tertiary academic adult ED between July 1 and Dec 1, 2018, who were requested a blood product by an emergency doctor, were included in the study.

Blood product requests and transfusion decisions were made by emergency doctors, and the clinical decisions and patient management process were not interfered with. The demographic characteristics and comorbidities of the patients; the clinical indications of the blood products requests, requested blood product types, amounts, and transfusion numbers were recorded. The crossmatch/transfusion ratio (CTR) and transfusion ratio (TR) values were calculated. Hemoglobin (Hb, g/dL), hematocrit (Hct, %), mean erythrocyte volume (MCV, fL), red blood cell distribution width (RDW, %), mean platelet volume (MPV, fL), plateletcrit (PCT, %), platelet count (plt, 10^3 mm^3), activated partial thromboplastin time (aPTT in seconds), international normalized ratio (INR), fibrinogen (mg/dL), and Glasgow Blatchford Scores were also recorded.

This study was the doctoral thesis of one of the authors and was approved by the local non-interventional ethics committee with approval ID: GO 18/498-21, dated June 5, 2018.

Participants and Measurements

Within the scope of the study, a total of 213 patients who were requested blood products and provided consent to participate were examined. Patients (n=8) who were transferred to another center for blood product transfusion were excluded from the study. *Crossmatch-transfusion rate (CTR)* was used to evaluate the blood product request and utilization practices in the hospitals. A ratio of 1 indicates that all requested blood products were transfused, and no unnecessary requests were made. *Transfusion rate* (TR) was defined as the percentage of transfused blood products to crossmatched products (3,4).

Glasgow Blatchford Score is a scoring system that incorporates vital signs, physical examination findings, patient history, and laboratory parameters to assist clinicians in determining acute treatment needs for gastrointestinal bleeding (5).

The presence of any of the following symptoms along with anemia was considered symptomatic anemia: Bleeding, weakness, fatigue, tachycardia, tachypnea, palpitations, shortness of breath, especially on exertion, near syncope, syncope, chest pain and decreased exercise tolerance, hypotension, or pallor of the skin.

The first diagnosis the clinician thought of when the patient was admitted was the preliminary diagnosis. After the results were obtained and all procedures were completed, the patient's diagnosis was expressed as the final diagnosis.

Statistical Analyses

Statistical analyses were performed using IBM SPSS for Windows Version 22.0 package program.

Numerical variables were summarized as mean ± standard deviation and median [min - max] values, while categorical variables were presented as numbers and percentages. The normality of numerical variables was assessed using the Kolmogorov-Smirnov test, and the equality of variances among groups was examined using Levene's test. The Kruskal-Wallis test was used to compare more than two groups. The Spearman correlation coefficient was used to assess the relationship between numerical variables. The chi-square test was employed to determine the relationship between categorical variables. The cut-off points for distinguishing between the groups of used blood products was determined through ROC curve analysis. Sensitivity and specificity values for the optimal cut-off point were reported, and the area under the ROC curve was calculated. The significance level was accepted as $p<0.05$.

Results

The mean age of the total 213 patients was 57.68 ± 18.794 years, and 60.6% (n=129) of them were male. Comorbidities were present in 77% (n=164) of the patients. The most common comorbid disease was non-hematological malignancy with a ratio of 29.1% (n=62) (Table I). A total of 53.5% (n=114) of patients had signs of active bleeding.

According to the indications for blood product requests, the preliminary diagnoses of the patients and the percentages were as follows: Hemorrhagic shock 9.9% (n=21), cardiogenic shock 0.9% (n=2), septic shock 6.1% (n=13), symptomatic anemia of unknown cause 32.9% (n=70), intracranial hemorrhage 1.4% (n=3), trauma 18.3% (n=39), gastrointestinal bleeding 13.6% (n=29), thrombocytopenia 2.8% (n=6) and coagulopathies 5.6% (n=1). Blood products were prepared for urgent surgery in 22.5% (n=48) of the patients.

If examined in terms of their final diagnosis, 23% (n=49) had gastrointestinal system bleeding, 18.8% trauma (n=40), 7% shock (n=15), 2.3% a need secondary to a defined malignancy (n=5), 22.1% anemia (n=47), 6.6% bleeding from a mass (n=14), 4.7% hemoptysis (n=10), 2.3% thrombocytopenia (n=5), 1.4% intracranial hemorrhage (n=3), 3.8% elevated INR (n=8), 1.9% epistaxis (n=4), and 1.9% had aortic dissection (n=4).

In this study, it was found that a total of 1,475 blood product units were requested for a total of 213 patients: 719 units of ESs, 445 units of thrombocyte suspensions (TSs), 309 units of fresh frozen plasma (FFP), and 2 units of cryoprecipitates. Table II presents the data on blood product requests and the amounts transfused.

Table I. Baseline characteristics of patients.

Features	n (%)
Age, years[a]	57.68 ± 18.794
Gender, male	129 (60.6)
Comorbid disease[*]	164 (77.0)
Non-hematologic malignancy	62 (29.1)
Hypertension	58 (27.2)
Coronary artery disease	41 (19.2)
Diabetes mellitus	29 (13.2)
Hematologic malignancy	21 (9.9)
Chronic kidney disease	17 (8)
Chronic liver disease	11 (5.2)
Aplastic anemia	4 (1.8)
Factor VIII deficiency	3 (1.4)
Osler-Weber disease	1 (0.4)
Hemolytic anemia	1 (0.4)
Polycythemia vera	1 (0.4)
Thalassemia major	1 (0.4)
Platelet function disorder	1 (0.4)

[a]: Mean ± SD; *: Some patients had multiple comorbidities.

For patients with gastrointestinal bleeding, the usage rates of blood products were 30.04% for ESs, 31.9% for TSs, and 60.56% for FFP. In trauma patients, the usage rates were 12.75% for ESs, 0.083% for TSs, and 13.89% for FFP. ESs and TSs were used significantly higher in the case of symptomatic anemia without signs of active bleeding compared to other indications such as gastrointestinal bleeding and trauma ($p<0.001$; $p<0.002$, respectively). FFP was most commonly used for cases with high INR values ($p<0.010$). The rates of blood product usage according to the indications are presented in Table III.

Table II. Distribution of data on blood products requested and transfused

Blood products	Erythrocyte Suspension	Thrombocyte Suspension	Fresh Frozen Plasma	Total
Request, unit	719	445	309	1,475*
Usage, unit	294	114	137	545
Transfusion rate (%) (Number of transfused units / Number of crossmatches)	40.89	25.61	44.34	36.9
Crossmatch/transfusion ratio (Number of crossmatches/ Number of transfused units)	2.44	3.90	2.25	2.70
Average request per patient, units**	3.38 ± 2.451	2.09 ± 4.301	1.45 ± 3.13	6.92
Average usage per patient, units**	1.45± 2.036	0.54 ± 1.661	0.64 ± 2.045	2.56

*2 patients were requested for cryoprecipitate. **Mean ± SD.

The mean values of Hb, Htc, MCV, RDW, aPTT, fibrinogen, platelet, and platelet volume of the patients are presented in Table IV. There was a moderate negative correlation between the initial hemoglobin values of the patients and the usage ratios of ESs (*r=-0.645; p<0.001*).

Table III. Evaluation of the utilization rates of blood products based on indications for request

Blood Products And Request İndications	Usage Rate %	*p value**
Erythrocyte Suspension		*<0.001*
Symptomatic anemia (without bleeding)	64.73	
Shock	51.11	
Gastrointestinal bleeding	30.04	
Trauma	12.75	
Thrombocyte Suspension		*<0.002*
Symptomatic anemia (without bleeding)	51.30	
Gastrointestinal bleeding	31.9	
Trauma	0.083	
Fresh Frozen Plasma		*<0.010*
Elevated INR	64.58	
Gastrointestinal bleeding	60.56	
Trauma	13.89	

**p< 0.05* is significant. INR: International normalized ratio

Table IV. Pre-transfusion laboratory results of patients

	Mean value	Standard Deviation	Minimum	Maximum
Hemoglobin (gr/dL)	9.615	3.4572	1.9	19.9
Hematocrit (%)	29.287	10.2065	11.5	62.9
MCV (fL)	86.68	13.582	22	146
RDW (%)	17.45	4.552	10	43
aPTT (sn)	28.06	16.255	11	160
INR	1.4835	1.05359	0.70	9.30
Fibrinogen (mg/dL)	404.08	177.238	64	950
Platelet (/µL)	205805.16	180339.501	3000	1680000
MPV (fL)	8.514	1.4452	0.8	14.2
PCT (%)	0.17934	0.262964	0.003	3.600

MCV: Mean erythrocyte volume, RDW: Red blood cell distribution width, aPTT: Activated partial thromboplastin time, INR: International normalized ratio, MPV: Mean platelet volume, PCT: Plateletcrit

Discussion

Since emergency physician acts in the nature of making quick decisions and providing patient stabilization, they tend to request blood products excessively. This may cause unnecessary demand or improper consumption of blood product reserves. As a matter of fact, in our study, it was seen that 63% of the blood product requests were not used. The low transfusion rate and high CTR reveal the gravity of the issue.

According to our study that ESs and TSs were the most preferred blood products among blood transfusions by emergency physicians due to symptomatic anemia of unknown cause without signs of active bleeding. Gastrointestinal bleeding was the second-line indication with the highest number of ESs, TSs, and FFP requests; traumas were the third.

The blood transfusion rate in ED, the first visiting and intervention place for critically ill patients, have been increased compared to other clinical departments in recent years (1). It reveals the necessity of planning for blood transfusion management in EDs. Within the framework of these plans, it is important to properly evaluate each patient before administering a blood transfusion. This helps to ensure that the transfusion is necessary and that the correct type and amount of blood product is used. By doing so, we can avoid unnecessary transfusions and reduce the over-request of blood products. Today, blood products found to

be compatible are reserved on behalf of the patients after the compatibility tests between the patients requested for blood products, and the products are studied in blood centers. Afterward, it is kept in the inventory for specified periods and cannot be used for another patient before expiration. This makes it difficult for blood products to be used within their limited life and causes problems such as clot formation, segmentation, and hemolysis, especially in ESs. Emergency physicians' tendencies to request large volumes of blood products as part of their habits or routines; causes a series of problems, ranging from increased percentages of reserved blood products, inventory problems, deterioration of cells in these products due to inappropriate storage conditions, loss of shelf life, increased costs, and destruction of the blood product before it can be transported. Many studies have shown that transfusion rates are pretty low compared to the amount of blood requested (6-9).

Approximately 61% of the patients in our study were male. The mean age of all patients was 57.68 ± 16.45. In a study conducted by Kelly et al. in ED, the mean age of 255 transfused patients was 67, with 63% male (10). Cobain et al. examined the demographic data of patients who received a blood transfusion in the United States, England, Germany, and Australia and they reported that most of the transfused patients were male (range 51-52.7%), and transfusion rates increased with increasing age (11).

When the underlying diseases of the patients were examined, many comorbid diseases were detected, especially hematological and non-hematological malignancies. This depends on the population of our hospital patient profiles (our hospital has a large oncologic center). The final diagnoses of blood product requests were as follows, in request from most to least: gastrointestinal bleeding (23%), anemia (22.1%), trauma (18.8%), shock (7%), hemoptysis (4.7%), and high INR (3.8%). Other studies on this issue reported that the most common cause of transfusion was gastrointestinal bleeding (10-12). Although the rates varied in our study, blood product requests were mostly due to gastrointestinal bleeding and anemia, consistent with the literature.

The literature has reported that blood product usage rates vary between 39-66.4% (9, 10, 13). In our study, the blood product request/use rate was 36.9%. Our study's low demand/use rate was likely due to the high number of blood product requests made early in the admission of unstable patients to the ED.

In this study, in which a total of 719 units of ESs were requested (mean 3.38 ± 2.241 units) for 213 patients, we found that only 294 units (mean 1.45 ± 2.036 units) were transfused. The CTR of this tertiary ED was 2.44, and its TR was 40.89%. We revealed that only one out of every three units of ESs requests was transfused. In a study that included 1487 patients, blood requests and transfusion rates were examined over six months, and it was reported that the TR was 64.2% and the CTR was 1.6% throughout the hospital (9). In a study by Subramanian et al. examining 252 patients admitted to the trauma center, it was shown that the CTR was 2.5 (13). The results of our study show that the CTR is quite low, and the rate of unnecessary requests is high in blood transfusions in the ED.

The TR of ESs according to clinical indication in our study was as follows: symptomatic anemia 64.73%, shock 51.11%, gastrointestinal bleeding 30.04%, and trauma 12.75%. There was a significant difference between the rates of ESs use according to the diagnosis. The few rates of blood product use in trauma patients show that physicians habitually request inappropriate and excessive amounts of blood products at the time of first admission in these patients. It may be due to an urgency reflex, or it may be due to fear of malpractice. Health policies should take steps to prevent this misuse of resource utilization, and physicians should internalize clinical decision guides. The amount of unused blood product was observed to be quite high, especially in patients who started massive transfusion protocol. In a study by Dunbar et al. in which they examined the use and destruction of blood products due to massive transfusion protocols in three trauma centers, the rate of ESs use was 39-65%, the FFP usage rate was 43-66%, and thrombocyte use was found in patients who initiated massive transfusion protocols, unlike our center. It has been reported that the rate of use of cryoprecipitate varies between 67-93% (14).

It has been reported that using the Glasgow

Blatchford Scale would benefit studies conducted to evaluate the blood needs of gastrointestinal patients, the most frequently transfused patient group in EDs (15-17). In our study, the TR was found to be 30.04% for patients with gastrointestinal bleeding. A statistically significant moderate correlation was found between the Glasgow Blatchford Scale, which was examined to determine these patients' blood transfusion needs, and ESs use rates.

In our study, the mean Hb value for which transfusion was decided was 9.61±3.46 gr/dL, and the mean Htc value was 29.29±10.21%. In the study of Sadeghi et al., blood transfusions of 1000 patients were examined, and the mean Hb value before blood transfusions was found 7.4 ±2.3 gr/dL in ED; it was reported that it was 7.5 ±1.0 gr/dL in internal services, 10.4 ± 2.6 gr/dL in surgical services, and 9.1±2.3 gr/dL in intensive care units. It was determined that 22% of the patients (n=219) received ESs transfusions inappropriately and unnecessarily, even though the Hb value was greater than 10 g/dL (18). In the study of Diaz et al., the data of patients who received a total of 908 units of ESs transfusion in the ED were examined, and it was shown that 21.4% of blood transfusions were performed with inappropriate indications, according to pre-transfusion Hb values. 100% of the transfusion decision in patients with Hb value <7 g/dL, 95% in patients with Hb 7.0-7.9 g/dL, and Hb 8.0-8.9 gr/dL was reported to be 71% accurate (1). In a study by Kelly et al. in ED, the mean Hb value before transfusion was found to be 8.14 ±2.59 gr/dL (10). The Hb transfusion threshold value specified in the blood transfusion guidelines is 7-8 gr/dL on average (19-21). In our study, the mean Hb value before transfusion was higher in the ED compared to the literature, indicating that ESs transfusions were performed inconsistently with the guidelines' recommendations. Making incorrect decisions regarding ES transfusion can result in an increase in unnecessary requests.

In our study, the TSs transfusion rate was 25.61%. When evaluated according to the diagnoses, it was seen that this rate was 31.9% in gastrointestinal bleeding patients and 0.083% in trauma patients. In our study, there was a statistically significant moderate negative correlation between the rate of transfused TSs and PCT value *(r=0.407; p=0.001)*. Our literature review found no study on the correlation between PCT and blood transfusion rate.

The study of Reed et al., examining the use of blood products in the ED of their center in previous years, revealed that due to the strategy they utilized, the rate of blood product requests decreased by 64%, and the rate of transfusion by 39% (22). Within the scope of the results of our study, we believe that blood transfusion strategies should be developed by making continuous analyses to improve ED blood transfusion management. Sharing feedback on blood product requests and use with emergency physicians and involving clinical guidelines routinely at every stage of patient management will provide continuous improvement (20, 23, 24). It will reduce unnecessary requests and improper usage of blood products.

Conclusion

In the ED, blood product requests are mainly for gastrointestinal bleeding and anemia. We have revealed that the blood product requests for trauma patients are not used to a large extent. Hospitals must develop their transfusion strategies and protocols to optimize blood transfusion and demand quantities, and all hospital units have to follow this protocol consistently.

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