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Distribution of pre- and mid-pandemic transfusions by blood types

Ayşe Yılmaz[1], Haydar Cerullah Zerde[2], Berna Alay[3], Veysel Garani Soylu[4]

[1]Kastamonu Training and Research Hospital, Department of Anestehesiology and Reanimation Kastamonu, Turkey
[2]Kastamonu Training and Research Hospital, Departman of Blood Transfusion, Kastamonu, Turkey
[3]Kastamonu Training and Research Hospital, Department of Pediatric İntensive Care Unit, Kastamonu, Turkey
[4]Kastamonu University Medicine Faculty, Department of Intensıve Care, Kastamonu, Turkey

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ABSTRACT

Introduction: COVID-19 disease spread rapidly worldwide, causing a pandemic. In this study, we aimed to explore the distribution of blood products in our blood center before and during the pandemic by blood type.

Material and Method: In this study, we retrospectively analyzed 4,271 blood products (1,290 patients) transfused before and during the pandemic through the medical records of Kastamonu Training and Research Hospital Blood Transfusion Center. Moreover, we investigated the associations between transfusions and age, sex, blood type, and COVID-19 infection.

Results: The findings revealed that the majority of the patients receiving transfusions both before and during the pandemic were A Rh (+) (41.4%). Besides, the rates of those with O Rh (+) were 28.8% and 28.7% during the pandemic. In addition, 37 products (28 erythrocyte suspensions, 7 fresh frozen plasma, 2 pooled platelet suspensions) were transfused on 17 patients with confirmed COVID-19.

Conclusion: Transfusions have an important place in the treatment of critically ill patients. The blood type A Rh (+) was previously shown to be associated with an increased risk of COVID-19 infection. In this study, although we realized that products of blood type A were mostly used in general transfusions, transfusions in the pandemic were performed predominantly with blood products of infected patients with blood type O. The modern world is more likely to encounter further pandemics in the future. We think that each region should evaluate its own centers.

Keywords: Transfusion, COVID-19, ABO blood types, rh, blood transfusion center

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INTRODUCTION

COVID-19, emerging in the Wuhan region of China in December 2019, has spread across the world and rapidly turned into a pandemic (1). It is transmitted through the respiratory tract and can be asymptomatic or symptomatic. While the incubation period of the virus is five days on average, 97.5% of symptoms may develop within 11.5 days (2). The research interest in the diagnosis, treatment, predisposing factors, and course of the disease is still fresh. In addition to many domains of life, the disease has affected the regular operations of many hospitals.

Blood transfusion became a relatively safe and viable procedure following the discovery of blood types in the 1900s and early World War I that citrate was a safe and effective anticoagulant (3). As expected, the works of blood centers have also been adversely affected by the pandemic and its undesirable consequences. The pandemic has led to a decrease in blood donations; thus, blood transfusion centers are likely to have difficulty obtaining blood (4,5). Nevertheless, healthcare service delivery should be maintained at its own pace to be able to satisfy the healthcare needs of individuals. Blood transfusion is life-saving and requires a sensitive approach to necessary procedures. For this reason, the proper analysis of blood products is of great importance. In their study, Hof L. et al. recommend taking patient-based measures (preventing anemia, reducing blood loss, etc.) for blood management of intensive care patients, especially due to the decrease in global blood donations owing to the pandemic (6). Ultimately, we aimed to evaluate how our blood center was affected by the pandemic regarding blood products by blood types.

Corresponding Author: Ayşe Yılmaz, drayseege@hotmail.com
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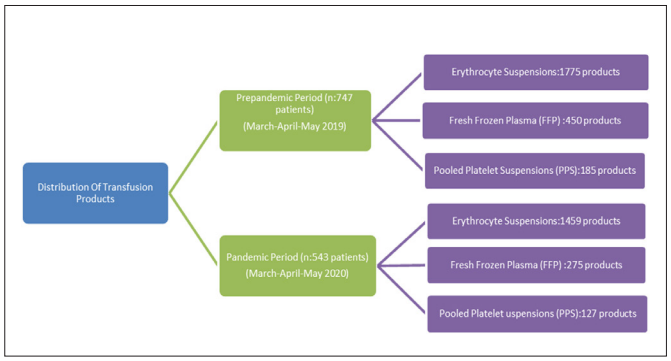
MATERIAL AND METHOD

The study was carried out with the permission of Kastamonu University Clinical Research Ethics Committee (Date: 14.12.2020, Decision No: 2020-KAEK-143-11). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

In this study, we recruited the records of our hospital's blood transfusion center to a retrospective analysis. We compared blood types in all transfusions in 3 busy months of the pandemic in our hospital and those in the same 3 months one year before the pandemic. In total, there were 1,290 patients undergoing blood transfusion, 747 before the pandemic and 543 in the first 3 months in the heyday of the pandemic. Transfusion procedures consisted of 3,234 erythrocyte suspensions (ES), 725 fresh frozen plasma (FFP), and 312 pooled platelet suspensions (PPS). Flow Chart 1 presents the distribution of transfusions by periods, patients, and products.



Flow Chart 1: The distribution of transfusions by periods, patients, and products

We also investigated the patients by age, sex, blood type, COVID-19 infection. Each patient receiving a blood transfusion in the pandemic was recruited to a Real-time polymerase chain reaction (rt-PCR). A definitive diagnosis of COVID-19 positivity was confirmed by our hospital's laboratory. Although some patients tested negative for COVID-19, they were considered suspicious considering their lung tomography imaging findings and received transfusions. Such transfusions were accepted as transfusions to COVID-19-suspected patients.

Statistical Analysis

We encoded and analyzed the data using SPSS version 22 (IBM). While descriptives were shown as numbers and percentages, we performed the Chi-Square test, Kruskal-Wallis test, and Fisher's Exact test to reveal the relationships between the variables. We considered a p-value <0.05 to be significant in all statistical analyses.

RESULTS

The results revealed that the transfusions in both periods significantly differed by sex ($p<0.05$), but it was not the case by age and blood type ($p>0.05$). More than half of the patients (56.4% in the pre-pandemic period and 61.9% in the pandemic period) were over 70 years old, and the distributions were similar for the other age groups. While the percentage of female patients receiving transfusions decreased from 60.8% (pre-pandemic) to 54.9% during the pandemic, the rate of male patients increased from 39.2% to 45.1%. We found that 41.1% of the patients were A Rh (+) in both periods, followed by 0 Rh (+) with the rates of 28.8% and 28.7%, respectively (**Table 1**).

Table 1. Distribution of patients by age, sex, and blood type

Factor	Group	Period		p
		Pre-pandemic	Mid-pandemic	
Age				0.17
	18-30 years	39 (5.2%)	18 (3.3%)	
	31-50 years	78 (10.4%)	55 (10.1%)	
	51-70 years	209 (28.0%)	134 (24.7%)	
	>70 years	421 (56.4%)	336 (61.9%)	
Sex				0.034
	Female	454 (60.8%)	298 (54.9%)	
	Male	293 (39.2%)	245 (45.1%)	
Blood Type				0.087
	A (Rh+)	309 (41.4%)	225 (41.4%)	
	A (Rh-)	47 (6.3%)	28 (5.2%)	
	B (Rh+)	83 (11.1%)	75 (13.8%)	
	B (Rh-)	7 (0.9%)	12 (2.2%)	
	0 (Rh+)	215 (28.8%)	156 (28.7%)	
	0 (Rh-)	37 (5.0%)	14 (2.6%)	
	AB (Rh+)	45 (6.0%)	27 (5.0%)	
	AB (Rh-)	4 (0.5%)	6 (1.1%)	

Considering the blood products (ES, FFP, and PPS), both groups (pre-pandemic and mid-pandemic) did not significantly differ by age and sex ($p> 0.05$). (**Table 2**).

On the product basis, for example, 285 of 309 A Rh (+) patients received ES transfusions in our hospital before the pandemic, and the utilization rate was 92.5%. These 285 patients received a total of 288 × 2.59 (± 2.18)=738 units of ES transfusions (Table 3). On the other hand, the blood types of the patients receiving ES, FFP, and PPS did not significantly differ by transfusion period ($p>0.05$). While more than 91% of the patients in all blood types received ES transfusion before the pandemic, it was 85% in all blood types during the pandemic. FFP was transfused to 14.3% - 25.0% of the patients in all blood types before the pandemic, and this range appeared between 14.3% and 35.7% during the pandemic. Finally, while the patients in all blood types were recruited to PPS transfusion up to 10.6% before the pandemic, this rate was up to 16.7% during the pandemic (**Table 3**).

Table 2. Distribution of the patients receiving ES, FFP, and PPS transfusions in both periods by age and sex

Transfusion Product	Erythrocyte Suspension (ES)		Fresh Frozen Plasma (FFP)		Pooled platelet suspensions (PPS)	
n: Number of Patients %: Percentage	Pre-pandemic (n %)	Mid-pandemic (n %)	Pre-pandemic (n %)	Mid-pandemic (n %)	Pre-pandemic (n %)	Mid-pandemic (n %)
Age						
18-30	38 (97.4%)	15 (83.3%)	8 (20.5%)	7 (38.9%)	1 (2.6%)	0 (0.0%)
31-50	73 (93.6%)	48 (87.3%)	19 (24.4%)	14 (25.5%)	7 (9.0%)	6 (10.9%)
51-70	199 (95.2%)	120 (89.6%)	32 (15.3%)	38 (28.4%)	14 (6.7%)	15 (11.2%)
>70	383 (91.0%)	307 (91.4%)	86 (20.4%)	59 (17.6%)	43 (10.2%)	37 (%11.0)
Sex						
Female	420 (92.5%)	271 (90.7%)	86 (18.9%)	60 (20.1%)	36 (7.9%)	31 (10.4%)
Male	273(3.2%)	219(9.4%)	59(20.1%)	58(23.7%)	29(9.9%)	27(7.2%)

Table 3. Distribution of the patients receiving ES, FFP, and PPS in both periods by blood type and numbers of transfusions

Blood Type	Erythrocyte Suspension				Fresh Frozen Plasma				Pooled platelet suspensions (PPS)			
	Pre-pandemic		Mid-pandemic		Pre-pandemic		Mid-pandemic		Pre-pandemic		Mid-pandemic	
	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD
A (Rh+)	285 92.5%	2.59 (±2.18)	204 90.7%	2.92 (±2.37)	54 17.5%	2.52 (±1.69)	49 21.8%	2.35 (±1.63)	28 9.1%	3.14 (±2.97)	21 9.3%	2.52 (±2.09)
A (Rh-)	44 93.6%	2.95 (±2.57)	27 90.7%	2.70 (±1.75)	11 23.4%	3.73 (±1.90)	4 14.3%	2.00 (±0.82)	5 10.6%	2.20 (±0.84)	3 10.7%	1.67 (±0.58)
B (Rh+)	78 94%	2.27 (±1.51)	64 96.4%	2.66 (±2.13)	13 15.7%	3.00 (±3.49)	17 22.7%	2.29 (±1.11)	5 6.0%	1.40 (±0.55)	11 14.7%	2.00 (±1.55)
B (Rh-)	7 100%	2.43 (±2.15)	12 100%	2.08 (±2.23)	1 14.3%	7.00 (-)	2 16.7%	1.50 (±0.71)	0 0%	-	2 16.7%	1.00 (±0.00)
0 (Rh+)	199 92.6%	2.61 (±2.55)	142 91%	3.13 (±2.41)	52 24.2%	3.35 (±3.72)	34 21.8%	2.50 (±2.54)	21 9.8%	3.00 (±2.59)	17 10.9%	2.06 (±1.48)
0 (Rh-)	34 91.9%	2.68 (±2.00)	12 85.7%	3.00 (±2.13)	6 16.2%	6.17 (±7.14)	5 35.7%	2.20 (±0.45)	2 5.4%	5.00 (±1.41)	0 0	-
AB Rh+)	42 93.3%	2.29 (±1.73)	23 85.2%	3.39 (±2.11)	7 15.6%	2.14 (±0.69)	5 18.5%	1.80 (±0.45)	4 8.9%	1.50 (±0.58)	3 11.1%	3.00 (±2.00)
AB (Rh-)	4 100%	1.25 (±0.50)	6 100%	3.50 (±3.51)	1 25%	1.00 (-)	2 33.3%	2.50 (±2.12)	0 0%	-	1 16.7%	1.00 (-)
Total		1775		1459		450		275		185		127

The patient groups (pre-pandemic and mid-pandemic) significantly differed by the number of product units (ES, FFP and PPS) ($p < 0.05$). In terms of blood type, we determined that while the mean number of ES transfusions was higher for all blood types, except for A Rh (-) and B Rh (-), during the pandemic, the patients with A Rh (-) and B Rh (-) received more ES before the pandemic (**Table 3**).

We also investigated blood product transfusions on the patients with confirmed and suspected COVID-19 by sex and age. Accordingly, the groups significantly differed in ES transfusion by age ($p < 0.05$), but it was not the case by sex ($p > 0.05$). Yet, there were no significant differences between the patients with confirmed and suspected COVID-19 in FFP and PPS transfusion by age and sex ($p > 0.05$). Finally, considering the blood types of the COVID-19-positive patients receiving transfusions, we found significant differences between their blood types by blood product ($p < 0.05$). We determined that 17 patients with confirmed COVID-19 received a total of 37 transfusions. Of the 28 ES transfusions on 13 patients, while 10 were for patients with A Rh (+), 2 were for patients with A Rh (-), and 16 were for patients with O Rh (+). Among 7 FFP transfusions on 3 patients, 1 was for a patient with B Rh (+) while 6 were for patients with O Rh (+). Regarding PPS transfusions, 2 were for a patient with O Rh (+) (**Table 4**).

DISCUSSION

In our study, more than half of the patients (56.4% before the pandemic and 61.9% during the pandemic) were over 70 years old, and the distributions were similar for the other age groups. The patients differed significantly by sex ($p < 0.05$). Considering blood types, the majority of the patients were A Rh (+), followed by O Rh (+).

In the literature, there is a growing research interest in blood types. In a study with 2,586 patients infected with COVID-19, the researchers determined the blood types of the patients as follows: 29.93% (A), 41.80% (B), 21.19% (O), and 7.98% (AB), respectively. Moreover, 98.07% of the patients were Rh positive (7).

Table 4. Distribution of the COVID-19-suspected and -positive patients receiving ES, FFP, and PPS in both periods by blood type and numbers of transfusions

Blood Type	Erythrocyte Suspension				Fresh Frozen Plasma				Pooled platelet suspensions (PPS)			
	Suspicious		Positive		Suspicious		Positive		Suspicious		Positive	
	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD	n %	M±SD
A (Rh+)	25 (100.0%)	2.64 (±1.38)	4 (100.0%)	2.50 (±1.73)	5 (20.0%)	2.00 (±1.00)	0 (0.0%)	-	8 (32.0%)	3.50 (±2.88)	0 (0.0%)	-
A (Rh-)	1 (50.0%)	2.00 (-)	2 (100.0%)	1.00 (±0.00)	1 (50.0%)	1.00 (-)	0 (0.0%)	-	1 (50.0%)	1.00 (-)	0 (0.0%)	-
B (Rh+)	5 (62.5%)	3.60 (±2.41)	0 (0.0%)	-	3 (37.5%)	2.67 (±2.08)	1 (100.0%)	1.00 (-)	3 (37.5%)	2.00 (±1.00)	0 (0.0%)	-
B (Rh-)	1 (100.0%)	9.00 (-)	-	-	0 (0.0%)	-	-	-	1 (100.0%)	1.00 (-)	-	-
0 (Rh+)	11 (73.3%)	4.91 (±4.04)	7 (100.0%)	2.29 (±2.63)	4 (26.7%)	2.00 (±1.41)	2 (28.6%)	3.00 (±1.41)	1 (6.7%)	1.00 (-)	2 (28.6%)	1.00 (±0.00)
0 (Rh-)	-	-	-	-	-	-	-	-	-	-	-	-
AB Rh+)	3 (100.0%)	2.67 (±1.53)	-	-	0 (0.0%)	-	-	-	0 (0.0%)	-	-	-
AB (Rh-)	1 (100.0%)	8.00 (-)	-	-	1 (100.0%)	4.00 (-)	-	-	0 (0.0%)	-	-	-
Total		165		28		31		7		37		2

The records of blood centers are the primary sources for the most accurate information on the distribution of blood types in countries. In our country, a recent study showed that, among the donors applying to a blood center, 42.84% were A (+), 32.67% were O, 16.46% were B, and 8.03% were AB (8). In our study, we found that 41.4% of those receiving blood transfusions before and during the pandemic were A Rh (+), which is rather close to the finding of the abovementioned study. They were followed by the patients with O Rh (+) at the rates of 28.8% before the pandemic and 28.7% during the pandemic. J. Torabizade Maatoghi et al. (9) examined the blood types of 29,922 donors from their blood center records and found that the majority of the donors were O (40.21%), followed by A.

In their study, Massimo Franchini et al. (10) reported that stated that ABO blood types are distinctive in the formation of many diseases, including cardiovascular diseases and malignancies, which may reinforce the importance of blood types and blood transfusion in diseases. Therefore, considering that an unknown disease, such as COVID-19, has been fought recently, we believe that physicians should reconsider the issue of blood transfusion decision, supply, and application.

Yalaoui S. et al. (11) compared the phenotypes of the blood types of 51 COVID-19 patients and 1,506 non-COVID 19 patients. As a result, they found that the prevalence of blood type A was high in both groups, which is consistent with our study.

Boudin L. et al. (12) examined the relationship between blood type and COVID-19 in young and healthy 1,769 crew members quarantined due to COVID-19 exposure. The results revealed that young adults actually were not at more or less risk for SARS-CoV-2 by blood type.

Simon J Stanworth et al. (13) compiled several studies on this subject and attempted to establish a protocol on the use of blood and blood products. In this review, the authors concluded that a decrease in the use of erythrocytes caused an increase in the use of plasma. On the other hand, the use of platelets was stated as a poor prognostic factor of the course of COVID-19. However, this study supported the view that the work in blood centers would be difficult due to a decrease in blood donations. Pal S. et al. (14) compared the transfusions in their hospital in the first five months of 2020. Although there were significant reductions in the number of patients requiring transfusion (39.69%) thanks to strict COVID-19 measures, they also witnessed a considerable decrease in the number of red blood cell products used (46.41%) and the number of fresh frozen plasma units and platelet concentrates (30%).

In a study with more than 31,100 samples, it was found that blood type A may be more susceptible to COVID-19, while blood type O may be less susceptible to COVID-19 (15). In another study, the pooled frequencies of blood types A, B, O, and AB among individuals infected with COVID-19 were reported as 36.22%, 24.99%, 29.67%, and 9.29%, respectively (16). In their study, Li J et al. (17) recommended that people with blood type A should strengthen their immune to reduce the risk of infection and that people with blood type O should not underestimate the virus and take precautions to avoid the risk of infection.

Although blood type A is more common in our country, we concluded that the CoVID-19 patients with blood type O needed transfusions the most, which overlaps the findings suggesting no association between blood type and the COVID-19 disease.

Convalescent immune plasma is often used in the treatment of patients with COVID-19 (18,19). However, we only investigated plasma used for reasons such as bleeding disorders, disseminated intravascular coagulation, and drug-induced bleeding (20). Our findings showed that there was no significant difference in the amount of plasma used for the abovementioned reasons before and during the pandemic, which implies that COVID-19 does not cause an increase in plasma use, except for convalescent plasma.

There are studies showing that there may be thrombocytopenia in the COVID-19 disease, which is associated with the severity of the disease (21). Marcos S.Z et al. (22) determined that the relationship between COVID-19 and thrombocytopenia was high in blood type B while it was low in blood type O. Based on our records, we found that blood type A platelets were the most needed platelets in PPS transfusions, followed by blood type O platelets. Moreover, the COVID-19 patients needing blood transfussions received PPS transfusions the most.

CONCLUSION

Overall, we interestingly concluded that blood products of blood type O were more prevalently used for COVID-19 patients, although general transfusions often required the products of blood type A which was determined as the most common blood type in our study. The modern world is more likely to encounter further pandemics in the future. We think that each region should evaluate its own centers.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kastamonu University Clinical Research Ethics Committee (Date: 14.12.2020, Decision No: 2020-KAEK-143-11).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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