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Relationship between the ABO blood group and mortality among the COVID-19 patients

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ABSTRACT

Objective: Differences in blood group antigen expression may increase or decrease the sensitivity of the host to many infections. Our aim in this study is to examine the relationship between ABO and Rh blood groups of COVID-19 patients and their mortality.

Material and Method: This retrospective observational study was conducted with patients who were diagnosed with COVID-19 in the emergency department of a tertiary hospital between May 1, 2020, and November 1, 2020. Patients who had a positive COVID-19 RT-PCR test and had blood group information in the HIMS database were included in the study. Blood groups, age, and gender information of the patients who included in the study were recorded on a form.

Results: The population of this study consists of 356 patients, of which 171 were women and 185 were men. There were 94 people in the O blood group, 185 people in the A blood group, 48 people in the B blood group, 29 people in the AB blood group, 37 people in the Rh-negative blood group, 319 people in the Rh-positive blood group. When the mortality status between blood groups is examined, it was observed that COVID-19 was less mortal in men with O blood group (p= 0.002).

Conclusion: COVID-19 infection is more common in those with the A blood group compared to the other groups. Additionally, we concluded that being in the O blood group is a factor that reduces mortality in men. More studies with a larger sample size are needed to confirm the results of our study.

Keywords: Blood groups, COVID-19, mortality

INTRODUCTION

COVID-19, the disease caused by the SARS-COV 2 virus, has led to a global epidemic (1). The SARS-COV2 virus has had various effects on the global population. It has been proven that older people and those with comorbidities such as cardiovascular disease, diabetes, and lung diseases are more vulnerable to severe disease of COVID-19 (2-5). To understand the underlying causes of morbidity and mortality associated with COVID-19, there has been a scientific interest to uncover characteristics that may make individuals more susceptible to COVID-19 infection and to identify risk factors associated with disease severity (6-9).

Data from Wuhan, China, the first epicenter of the COVID-19 epidemic, have shown the link between the ABO blood groups and COVID-19 infections. In a multicenter study conducted in the Wuhan region, Zhao et al. compared the general population with 2173 COVID-19 patients in terms of ABO blood groups. They reported that blood group A was associated with higher COVID-19 positivity compared to non-A groups and blood group O was associated with a significantly lower risk of infection compared to non-O groups (10).

Our aim in this study is to investigate the relationship between blood groups of COVID-19 patients and their mortality.

MATERIAL AND METHOD

After the approval of the Research Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Date: 29.03.2021, Decision No: 2021/514/198/29). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. This retrospective observational study was carried out with the information of patients admitted to the ED of a tertiary hospital between May 1, 2020, and November 1, 2020.

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Data of all patients over the 18-year-old and admitted to ED with suspected COVID-19 between September 1, 2020, and December 1, 2020, were scanned in the Hospital Information Management System (HIMS). The patients who had positive results in the real-time Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) test of nasal and pharyngeal swab samples included the study (11). The diagnosis of COVID-19 was determined based on the World Health Organization (WHO) guidelines. Patients whose RT-PCR results were negative or blood group information could not be reached were excluded from the study. Blood group information of patients diagnosed with COVID-19 was obtained from the hospital blood bank. Chronic disease information of the study population including chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), chronic renal failure (CRF), chronic neurological disease (CND), diabetes mellitus (DM), hypertension (HT), coronary artery disease (CAD) and atrial fibrillation (AF) were obtained from HIMS digital recordings.

Statistical Analysis

Statistical analyzes were performed using IBM SPSS Statistics 26 software. Mann-Whitney U test was used for the analysis of continuous data, Chi-square and Fisher's exact tests were used for the analysis of categorical data. Continuous data are reported as medians and interquartile ranges (IQR) and categorical data were reported as frequency and percentage (**Table 1, 2** and **3**). A p-value of less than 0.05 was considered statistically significant.

RESULTS

The population of this study consisted of 356 patients, of which 171 were women and 185 were men. There were 251 patients in the survivor group and 105 in the non-survivor group (**Table 1**). The median age of the study population was 64 (49-76), while the minimum age was 19, and the maximum age was 97. The median age of the survivor group was 58 (45-70), while the median age was 75 (65-82) for the non-survivor group (**Table 1**).

When the relation of chronic diseases with mortality was examined in the study population, there was a significant difference between survivor and non-survivor groups for COPD, CHF, CRF, and CND (**Table1**). Also, there was no significant difference between survivor and non-survivor groups for DM, HT, CAD, and AF (**Table 1**).

The study population consists of 94 people in blood group O, 185 in blood group A, 48 in blood group B, 29 in blood group AB, 37 in Rh-negative blood group, 319 in Rh-positive blood group (**Table 2**).

When patients grouped according to ABO blood groups were compared in terms of mortality, there was no significant difference between the groups (**Table 2**). In addition, no significant difference was found between the patients in the Rh-negative and Rh-positive groups in terms of mortality (**Table 2**).

When the relationship between mortality and ABO blood groups was assessed in COVID-19 patients classified by gender, there was a statistically significant difference between the O blood group with non-O groups for men (**Figure 1**, **Table 3**). This significant difference is important

Table 1. Demographic and comorbidity data of the study population

Variables	Category	Survivor		Non-survivor		Total	Sig.
		n	%	n	%	n	p
Gender	Female	124	72.5	47	27.5	171	0.424
	Male	127	68.6	58	31.4	185	
COPD	No	239	72	93	28	332	0.023
	Yes	12	50	12	50	24	
DM	No	188	71.2	76	28.8	264	0.620
	Yes	63	68.5	29	31.5	92	
HT	No	162	72	63	28	225	0.418
	Yes	89	67.9	42	32.1	131	
CHF	No	238	72.8	89	27.2	327	0.002
	Yes	13	44.8	16	55.2	29	
CAD	No	226	71.5	90	28.5	316	0.239
	Yes	25	62.5	15	37.5	40	
AF	No	242	71	99	29	341	0.362
	Yes	9	60	6	40	15	
CRF	No	236	72.6	89	27.4	325	0.005
	Yes	15	48.4	16	51.6	31	
CND	No	240	73.6	86	26.4	326	<0.001
	Yes	11	36.7	19	63.3	30	
		Survivor		Non-survivor		Total	
		Median	IQR	Median	IQR	Median IQR	
Age		58	45-70	75	65-82	64 49-76	<0.001

COPD: Chronic Obstructive Pulmonary Disease, DM: Diabetes Mellitus, HT: Hypertension, CHF: Congestive Heart Failure, CAD: Coronary Artery Disease, AF: Atrial Fibrillation, CRF: Chronic Renal Failure, CND: Chronic Neurological Disease Sig: Significance

as it shows that COVID-19 disease has low mortality in men with blood group O. When the relationship was investigated between mortality and ABO or Rh blood groups in COVID-19 patients classified by gender, no statistically significant relationship was found for the groups other than group O (**Table 3**).

Table 2. Relationship between mortality and blood groups in COVID-19 patients

Variables	Category	Survivor		Non-survivor		Total n	Significance p
		n	%	n	%		
O blood group	O	70	74.5	24	25.5	94	0.326
	Non-O	181	69.1	81	30.9	262	
A blood group	A	128	69.2	57	30.8	185	0.571
	Non-A	123	71.9	48	28.1	171	
B blood group	B	32	66.7	16	33.3	48	0.531
	Non-B	219	71.1	89	28.9	308	
AB blood group	AB	21	72.4	8	27.6	29	0.814
	Non-AB	230	70.3	97	29.7	327	
Rh blood group	Rh (+)	226	70.8	93	29.2	319	0.679
	Rh (-)	25	67.6	12	32.4	37	

Tablo 3. Relationship between mortality and blood groups in COVID-19 patients when grouped by gender

Gender	Category	Survivor		Non-survivor		Total n	Sig. p
		n	%	n	%		
Female (n=171)	O	30	62.5	18	37.5	48	0.067
	Non-O	94	76.4	29	23.6	123	
	A	67	76.1	21	23.9	88	0.275
	Non-A	57	68.7	26	31.3	83	
	B	17	70.8	7	29.2	24	0.842
	Non-B	107	72.8	40	27.2	147	
	AB	10	90.9	1	9.1	11	0.293*
	Non-AB	114	71.3	46	28.7	160	
	Rh (+)	112	71.8	44	28.2	156	0.763*
	Rh (-)	12	80	3	20	15	
Male (n=185)	O	40	87.0	6	13.0	46	0.002
	Non-O	87	62.6	52	37.4	139	
	A	61	62.9	36	37.1	97	0.076
	Non-A	66	75.0	22	25.0	88	
	B	15	62.5	9	37.5	24	0.486
	Non-B	112	69.6	49	30.4	161	
	AB	11	61.1	7	38.9	18	0.468
	Non-AB	116	69.5	51	30.5	167	
	Rh (+)	114	69.9	49	30.1	163	0.303
	Rh (-)	13	59.1	9	40.9	22	

* p value of Fisher's Exact Test, Sig.: Significance

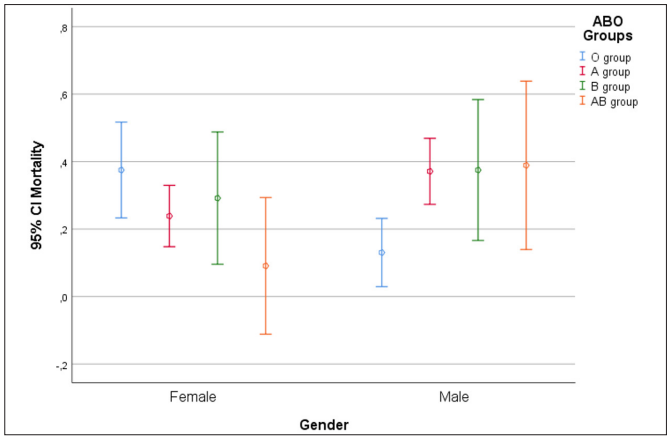

Figure 1. Bar graph in terms of mortality and ABO blood groups relationship of COVID-19 patients grouped by genders

DISCUSSION

In this study, the relationship between blood groups and mortality status of COVID-19 patients was examined. It was concluded that the disease was less mortal in the O blood group with male gender.

Landsteiner's ABO blood groups are carbohydrate epitopes found on the surface of human cells. Antigenic determinants trisaccharide parts of A and B blood groups are GalNAcα1-3 (Fuca1, 2) -Galβ- and Gala1-3- (Fuca1, 2) -Galβ-, O blood group antigen Fuca1, 2-Galβ-. While blood groups are genetically inherited, environmental factors can potentially affect which blood groups in a population will be passed on more frequently to the next generation. Viral infection sensitivity has previously been found to be associated with the blood ABO group. For example, blood group sensitivity of Norwalk virus and Hepatitis B is clear (12, 13).

Differences in blood group antigen expression can increase or decrease the sensitivity of the host to many infections. Therefore, since the beginning of the COVID-19 epidemic, many studies have been conducted on this subject. Zhao et al. studied the ABO blood group distribution in 2.173 COVID-19 patients. In this study, it was shown that the frequency of blood group A in COVID-19 patients was higher than that of non-A blood groups, and it was found that blood group O was associated with a lower risk of infection compared to non-O blood groups (10). Wu et al. (study included 187 COVID-19 patients) and H. Göker et al. (study included 186 COVID-19 patients) found similar results (14,15).

It is known that thrombotic risks are significantly reduced in the blood group O compared to non-O blood groups. Studies have shown that micro thrombosis developing in COVID-19 infection in the pulmonary vascular bed contributes significantly to acute respiratory syndrome, therefore the use of prophylactic anticoagulants is also included in the guidelines (16). There are opinions suggesting that the protective effect shown in O blood group is based on this phenomenon (17). In our study, the lower mortality rate in men with O blood group is consistent with the studies in the literature.

Blood groups are determined by sugars, and coronaviruses in cattle have surface proteins that bind to sugars. The extra sugar N-acetylgalactosamine on the surface of blood group A cells is likely to result in more pathogen exposure. This sugar is lacking in blood group O cells (18). This information is coherented with our results, such as that the majority of the population in the study consisted of individuals with blood group A and that blood group O is relatively protective.

As with any retrospective study, there are some limitations in this study. In this single-center study, the blood groups of the patients were found by querying from the electronic database of the hospital, and the patients whose blood groups could not be reached were not included in the study, resulting in a limited sample size. Another limitation of this study was the absence of a control group consisting of people who were not infected with COVID-19. However, the control group was not included in the study because COVID-19 infection can also be seen asymptomatically.

CONCLUSION

In this study, we concluded that those who with blood group A had more COVID-19 infections and that blood group O with male gender was more protective against the disease. More studies with a larger sample size are needed to confirm the results of our study.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Research Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Date: 29.03.2021, Decision No: 2021/514/198/29).

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: All authors also declare no conflict of interest.

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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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