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Association of ABO blood group and age with COVID-19 positive test

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SUMMARY

OBJECTIVE: The aim of this study is to evaluate the relation between the coronavirus (SARS-CoV-2) disease (COVID-19) and blood groups and the Rh factor.

METHOD: A total of 313 patients hospitalized in the Internal Medicine clinic, at the intensive care unit (ICU) were included in the study. The cases were divided into two groups: those who were COVID-19 positive and those negative, detected with real-time reverse transcription polymerase chain reaction testing. The demographic, clinical, ABO blood groups, and Rh factor data of the cases were obtained from the hospital records retrospectively.

RESULTS: The mean age of COVID-19 positive (+) cases was 57.74±16 years and of COVID-19 negative (-) cases, 66.41±15 years. The difference was significant (p<0.001); there was no difference between the two groups in terms of sex (p=0.634). When age was categorically separated in COVID-19 (+) cases, $\chi 2$ was extremely significant. Among the ABO blood groups of COVID-19 (+) and (-) cases, $\chi 2$ was 4.975 (p=0.174). In the logistic regression, it was 4.1 (p=0.011) in the O blood group. COVID-19 positive test was determined as 13, 4, and 4 times higher in the 31–40, 41–50, and 51–60 age groups, respectively (p=0.001, p=0.010, p=0.003).

CONCLUSION: The incidence of COVID-19 has increased in the younger population and in the O blood group. Our findings support that, in this population, the ABO blood groups can contribute to the early detection of COVID-19.

KEYWORDS: Coronavirus infections. ABO blood-group system. Rh-Hr blood-group system. COVID-19.

INTRODUCTION

The novel coronavirus (SARS-CoV-2), which causes COVID-19, declared as a pandemic by the World Health Organization (WHO), has affected the whole world. Difficulties in its diagnosis and treatment are present. Therefore, individuals at risk should be identified in relation to this disease.

The ABO blood group system is the most researched erythrocyte antigen system due to the easy identification of phenotypes[1]. The distribution of the ABO blood groups and Rh factor differs between ethnicities and nations[2]. Whereas the rate of Rh positivity in people of white skin color is around 85%, it reaches roughly 95% in African Americans, and almost 100% in African descendants[3]. Genetic factors such as blood group antigens may have an impact on the development and severity of some diseases. Many studies have shown that some diseases are associated with some blood groups. Many epithelial cells have blood group antigens on their surfaces. These antigens play a role in various biological processes, such as cell movement, differentiation, inflammation, and bacterial adhesion4.

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Various studies have shown a relation between predisposition to infectious diseases and blood groups5. The relation between various viruses, such as the West Nile6, HIV7, and SARS-CoV-1[8] and ABO blood groups have been identified. There are several speculations and several studies on the relation between ABO blood groups and SARS-CoV-2[9,10].

In this retrospective single-center study, we aimed to investigate whether there is a relation between COVID-19, which is an infectious viral disease, and ABO and the Rh groups.

METHOD

In the study, 313 patients who had been hospitalized in the internal medicine clinic and at the intensive care unit (ICU), who had been tested for COVID-19 with real-time reverse transcription polymerase chain reaction (rRT-PCR), between between 1 April 2020 and 30 May 2020, were included in the study. Out of the 313 cases, 21 died and 38 had been hospitalized at the intensive care unit. Nasal and pharyngeal swabs of all cases were collected. The isolated samples of patients, which had been transported with the VNAT viral transport and delivered to the molecular virology laboratory, had been studied by the Biospedy (Bioeksen, Turkey) rRT-PCR Kit, provided by the Ministry of Health. Those with positive rRT-PCR result were considered as COVID-19 positive (+), and those with 2 negative rRT-PCR results, 48 hours apart, were considered as COVID-19 negative (-). Hospital records (demographic, clinical, ABO blood groups, and Rh factor) of the patients older than 18 were analyzed retrospectively. The cases were divided into two groups: COVID-19 positive (+) and COVID-19 negative (-). The chest computed tomography (CT) reports of all cases were obtained by scanning the hospital data system retrospectively. Ethics committee approval was obtained from the Ministry of Health of the Republic of Turkey and Sakarya University Medical Faculty for the study (No.: 715224737050.01.04/131; April 04, 2020).

Statistical Analysis

Data analysis was performed by using statistical software (SPSS, version 10.0 [SPSS Inc,

Chicago, IL]. Normally distributed data were compared via one-way analysis of variance, and non–normally distributed data were compared via Mann-Whitney U test. Categorical associations were evaluated by using χ^2 test and multiple logistic regression analysis. Statistical significance was defined as $p \leq 0.05$.

RESULTS

A total of 145 (46.3%) out of the 313 cases were female, and 168 (53.7%) were male. COVID-19 was detected (+) in 220 of the 313 cases (70.3%). The mean age in COVID-19 (+) cases was 57.74±16 years; in (-) cases, 66.41±15 years, and this difference was significant (p<0.001); there was no difference between the two groups in terms of sex (χ^2=0.226, p=0.634). Similarly, there was no difference between COVID-19 (+) and (-) cases in terms of the ABO blood groups and Rh factor (χ^2=4.975, p=0.174; χ^2=0.002 p=0.968; respectively). The demographic characteristics of patients infected with SARS-CoV-2 have been demonstrated in Table 1. The age and ABO group in COVİD-19 (+) and (-) cases are displayed in Figure 1. (-) When the thoracic CT findings of the COVID-19 (+) and (-) cases were compared, the difference between the two groups was significant (χ^2=18.139, p=<0.001). The most common symptom of COVID (+) cases was cough. The comorbidities of COVID

Table 1. Demographic characteristics of patients infected with COVID-19.

Characteristics	COVID-19 (+) n 220	COVID-19 (-) n 93	p-value
Age, years old (SD)	57.74 (16)	66.41 (15)	0.001
Men (n)	120	48	0.710
Women (n)			0.362
Blood groups			
A	100	47	
B	32	13	0.174
AB	12	10	
O	76	23	
Rh	%	%	0.968
Positive	196	83	
Negative	24	10	
DM	41	41	0.990
HT	52	60	0.332
CAD	16	22	0.338
COLD	11	16	0.142
CHF	11	22	0.067
Malignity	11	23	0.034
CKD	10	25	0.006
CVD	9	8.5	0.979
Dialysis	8	14	0.190
AKF	5	4	0.431
Exitus	8.6	4.6	0.240

SD: Standard deviation; DM: Diabetes mellitus; HT: Hypertension; CAD: Coronary artery disease; COLD: Chronic obstructive lung disease; CHF: Congestive heart disease; CKD: Chronic kidney failure; CVD: Cerebro vasculary disease; AKF: Acut kidney failure.

(+) cases were hypertension (HT), diabetes mellitus, coronary artery disease (CAD), chronic obstructive lung disease, congestive heart disease, malignancy, chronic renal failure, and acute renal failure, respectively. There was no relation between sex and blood group (χ^2=5.619, p=0.132). The relation between blood groups and CAD was significant (χ^2=10.347, p=0.016), and the relation with HT was nearly significant (χ^2=7.031, p=0.071).

No relation was determined between the ABO group and COVID-19 positivity/negativity with the chi square test. However, there was a significant relation between age and COVID-19. Hence, further analysis was carried out using the logistic regression. We divided the patients into six groups, according to age (21–30, 31–40, 41–50, 51–60, 61–80, and 81–100) in order to explain the specific age range. The percentages of occurrence of COVID in the age ranges were 94%, 83%, 83%, 54%, 65%, and 54%, respectively. A logistic regression model was built, in which COVID-19 status was the independent variable and the AB0 blood group and age categories were the independent categorical covariates. COVID-19 positive AB0 blood type with the lowest prevalence and the age categories with the lowest prevalence were selected as indicator covariates. Our model revealed that patients with 0 blood type and those in the 31–40, 41–50, 51–60-year-old age groups were 4.1 and 13, 4, 4 times more likely to test positive for COVID-19, respectively (Table 2). ABO blood groups distribution among age groups is presented in Figure 2.

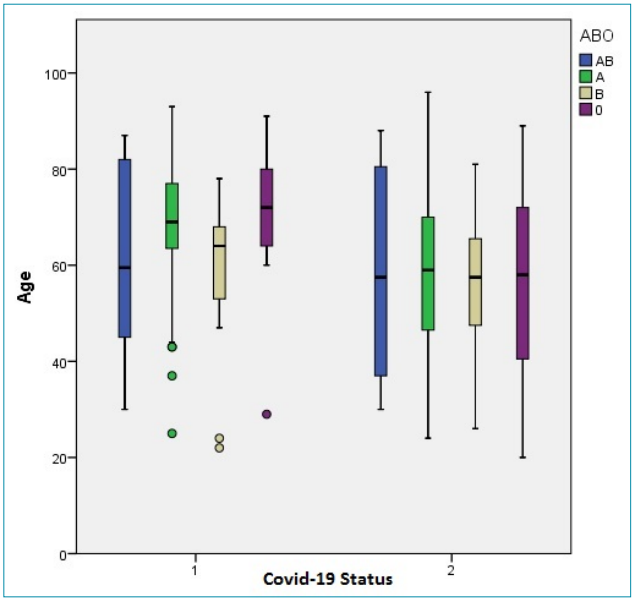

Figure 1. The age and ABO group in cases with and without COVID-19 (+).

There was no relation between the blood group and mortality (χ^2=2.376, p=0.498), and the mortality rate was the highest in group B. There was no relation between blood groups and patients hospitalized at the ICU (χ^2=2.903 p=0.407). The blood group of patients hospitalized at the ICU was O, most frequently.

There was no relation between the blood group and ward/intensive care unit hospitalization (χ^2=3.738, p=0.291).

There was no difference between Rh and sex, COVID, ward/intensive care unit hospitalization (χ^2=2.396, p=0.122; χ^2=0.002, p=0.962; χ^2=0.402, p=0.526, respectively). When rh was evaluated categorically by age, chi-square was 6.013, and p=0.538. Rh blood groups distribution according to age and COVID-19 status is presented in Figure 3. There was no relation

Table 2. Logistic regression model with COVID-19 status is the independent variable; blood group ABO and age categories are independent categorical covariates.

B		S.E	Wald	p	OR
Blood groups					
AB	0.910	0.714	6.940	0.074	2.523
A	0.925	0.527	3.082	0.079	2.555
B	0.979	0.605	2.618	0.106	2.685
O	1.403	0.550	6.575	0.011	4.096
Age cat (year)					
Agecat (21–30)	0.716	0.646	1.230	0.267	2.047
Agecat (31–40)	2.621	0.813	10.384	0.001	13.750
Agecat (41–50)	1.402	0.545	6.622	0.010	4.065
Agecat (51–60)	1.529	0.508	9.053	0.003	4.612
Agecat (61–80)	0.075	0.426	0.031	0.860	0.928
Agecat (81–100)	0.368	0.442	0.694	0.405	1.445

between the Rh factor and mortality (χ^2=2.590, p=0.108) either. There were 34 patients with Rh negativity in total, and three were at the ICU, but no death was seen.

DISCUSSION

The study reported the cohort of COVID-19 (+) 220 and COVID-19 (-) 93 hospitalized patients, confirmed with rRT-PCR. There were significant differences in COVID-19 positive cases in terms of age, compared to negative cases. The age was younger in COVID-19 positive cases. In the logistic regression, the probability of COVID-19 positive test was determined 4.1 times higher in the O blood group, and in the 31–40, 41–50, 51–60 age groups, it was found to be 13, 4, and 4 times higher, respectively. The reason for COVID-19 positivity being higher in these age groups was thought to be related to the fact that this patient group was not subject to curfews and traveling outside their country.

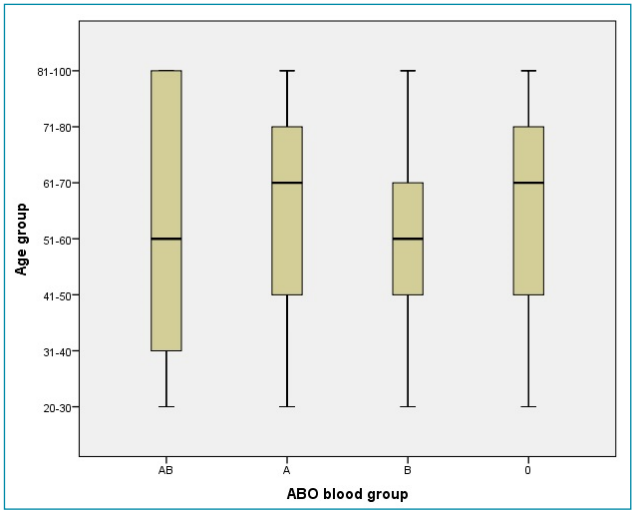

Figure 2. ABO blood group distribution among age groups.

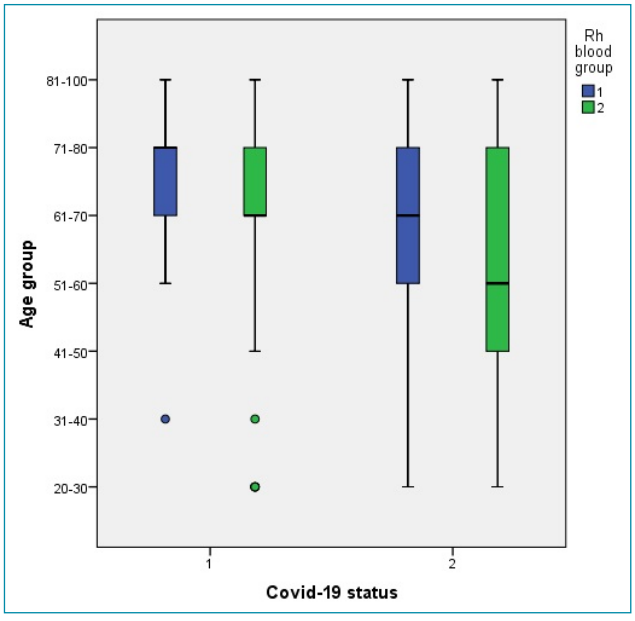

Figure 3. Rh blood group distribution according to age and COVID-19 status.

The ABO blood group system basically contains A and B antigens and their corresponding antibodies. There are 4 genetic forms: A, B, AB, and O[11]. Besides that, ABO gene variants that vary between different ethnic population groups are also known[2,12]. A relation between various viruses (such as the West Nile[6], HIV[7], hepatitis B[13], and SARS-CoV-1[8]) and ABO blood groups has been identified. Considering that there may be a relation between COVID-19 and blood groups, two studies have shown that the blood group A has a higher risk of developing COVID-19, and blood group O has a lower risk[9,10]. In the study by Zhao et al.[9], the control group comprised completely healthy individuals, and the lack of age and sex information of the control group was a disadvantage. In the study conducted by Wu et al.[10], the control group consisted of completely healthy individuals without COVID-19 testing. In our study, all cases were hospitalized and comprised cases with confirmed COVID-19 +/- with rRT-PCR.

In the present study, more COVID-19 positive cases were found within the blood group O. Dzik et al.[14] found a non-significant slightly higher proportion of blood group O's individuals among patients with COVID-19. Increased evidence has shown that the need for hospitalization due to this infection may be disproportionately affected by race and ethnicity in China and the United States, as well as other countries[15,16]. Since the blood group ABO and the Rh factor vary by ethnicity, the distribution of ABO when comparing the infected and the uninfected cohorts may be affected. Our data and those by Sunny Dzik[14] did not support the recommendations of Li et al.[17], that the blood group A's individuals should strengthen protection to reduce the risk of infection. People with blood type O should not underestimate this virus and must take precautions to avoid the risk of infection[17]. The 4.1 times higher frequency of COVID-19 positive test in blood group O found herein and the slight increase of COVID-19 disease found by Dzik et al.[14] in the blood group O in Boston may be related to race and ethni differences in blood group distribution[2]. This can be explained by the fact that the COVID-19 pandemic disproportionately affected those of Latin or Spanish descent in which the O group is more common in Boston[14,15]. Likewise, the increase in COVID-19 cases associated with blood group A in China may be related to the high incidence of blood type A [16]. In Turkey, although blood group A is common, the region in which we are located is an industrial area, which has ethnic origin differences and receives immigrants[18]. This may have affected our results.

There was no relation between blood type ABO and death among individuals hospitalized with COVID-19[9,14,19]. In the present study, no relation between the blood group and mortality consistent with previous studies was found; the mortality rate was the highest in blood group B. Our mortality count (n: 21) was a limiting factor in the statistical analysis.

It has been stated there is a relation between the Rh factor and COVID-19, as a result of a preprint study[19]. We could not find any relation between the Rh factor and mortality. However, there were no Rh (-) cases in patients who died. The Rh (-) case number herein was scarce (n: 34), which complicated the statistical analysis.

Present results emphasize that the populations used to compare blood group ABO distributions should be carefully selected, and further studies are needed.

In summary, people's blood group may be one of the risk factors for COVID-19. Blood groups may be associated with some clinical characteristics of patients with COVID-19.

AUTHORS' CONTRIBUTION

AN: Conceptualization, Data Curation, Formal Analysis, Supervision, Validation, Writing – Original Draft, Writing – Review & Editing. **TK:** Data Curation, Writing – Original Draft. **SY:** Data Curation, Writing – Original Draft. **CLW:** Conceptualization, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing. **HC:** Conceptualization, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing.

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