ASPI | Afarand Scholarly Publishing Institute; Turkey
ISSN: 7687-2645. Journal of Clinical Care and Skills. 2023;4(1):39-43. 10.58209/jccs.4.1.39

Journal of Clinical Care and Skills

Association of ABO Blood Group and the Risk of COVID-19 Infection

ARTICLE INFO

Article Type
Descriptive Study

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How to cite this article
Etemadfar P, Rad F, Rostami Yasuj Sh, Fakhari Gh, Esmaeili O S, Niazkar H R, Ghatee M A. Association of ABO Blood Group and the Risk of COVID-19 Infection. Journal of Clinical Care and Skills. 2023;4(1):39-43.

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Article History
Received: March 4, 2023
Accepted: March 20, 2023
ePublished: April 18, 2023

ABSTRACT

Aims Although the preliminary studies have reported that some ABO system antigens may predispose individuals to COVID-19 infection, their findings are still under debate. The present study aimed to investigate the association of ABO blood group with the risk of COVID-19 infection, its hematology findings and mortality.

Instruments & Methods This cross-sectional descriptive study was conducted in all patients referred to Shahid Jalil Hospital in Yasuj city, southwest Iran, due to the possibility of infection with COVID-19 from May to October 2021. Totally, 182 patients were recruited using the census method. Data were analyzed using Chi-Square, independent T, and one-way-ANOVA tests in SPSS 21 software.

Findings The ESR, red cell distribution width (RDW), and mean corpuscular hemoglobin concentration (MCHC) were significantly different between the COVID-19 negative and positive groups. There were no significant differences in ABO blood types between the COVID-19 positive and negative groups according to gender (p=0.148). There was no significant association between the ABO blood group phenotypes and the mean of demographic and laboratory information in the COVID-19 positive patients.

Conclusion There is no association between ABO blood groups and COVID-19 infection and its mortality.

Keywords ABO Blood Types; Cell-Typing; Back-Typing; COVID-19

CITATION LINKS

[1] COVID-19 and hematology findings based on the current ... [2] Laboratory medicine resilience during coronavirus disease 2019 ... [3] Assessment of depression, anxiety, stress, and posttraumatic stress disorder ... [4] A review on laboratory findings of patients with ... [5] The relationship between inflammatory cytokines and coagulopathy ... [6] Patients with congenital bleeding disorders appear to be less severely ... [7] Extrapulmonary Manifestations ... [8] Targeting inflammation and cytokine storm in ... [9] COVID-19 mortality and its predictors in the elderly: A systematic ... [10] The impact of ABO blood group on COVID-19 infection risk and mortality ... [11] Relationship between the ABO blood group and the coronavirus disease 2019 ... [12] COVID-19 and ABO blood group: Another ... [13] Association between ABO blood group system and COVID-19 susceptibility ... [14] ABO blood group and COVID-19: A review on behalf of the ... [15] Frequency of ABO and Rh blood groups in middle school students of ... [16] ABO blood groups are not associated with the risk of acquiring SARS-CoV-2 ... [17] COVID-19 and ABO blood ... [18] Correlation between ABO blood type, susceptibility to SARS-CoV-2 infection ... [19] The effects of blood group types on the risk of COVID-19 infection and ... [20] ABO phenotype and death in critically ill patients with ... [21] Role of ABO secretor status in mucosal innate immunity ... [22] Relationship between ABO blood group distribution and ... [23] The association of ABO blood group with indices of disease severity ... [24] Susceptibility to the novel coronavirus disease (COVID-19) is associated with ABO and Rh ... [25] The Lebanese COVID-19 cohort: A challenge for the ABO blood ... [26] ABO blood groups and the incidence of complications ... [27] HLA and AB0 polymorphisms may influence SARS-CoV-2 infection and COVID-19 ... [28] Correlation between ABO blood type, susceptibility to SARS-CoV-2 infection and COVID-19 disease severity ... [29] ABO blood groups in COVID-19 patients ... [30] The assessment of the relationship between ABO blood groups and ... [31] The effect of ABO blood group and antibody class on the risk of COVID-19 ... [32] Non-ABO red cell antibodies and risk of ... [33] Lewis and ABO histo-blood types and the secretor status of patients hospitalized ... [34] Are blood groups related to the distribution ... [35] Susceptibility of ABO blood group to COVID-19 infections ... [36] Association between ABO blood groups and rhesus antigen and ... [37] Association of ABO blood group type with ... [38] Association of ABO blood group and age with COVID-19 ... [39] Von Willebrand factor (vWF): Marker of endothelial ... [40] ABO blood group and outcomes in patients with COVID-19 ...

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the etiological agent of coronavirus disease 2019 (COVID-19), has infected more than 53.7 million individuals and led to more than 1.3 million deaths as of 15 November 2020 [1-4]. COVID-19 is somehow a disease with a thousand faces and patients may either experience an asymptomatic infection or present with various non-exclusive signs and symptoms such as fever, dry cough, sore throat, myalgia, anosmia, agnosia, chest pain, and confusion [5, 6]. Studies have estimated the incubation of COVID-19 to be between one to 14 days. Moreover, COVID-19 may lead to various complications such as Acute Respiratory Distress Syndrome (ARDS), and multi-organ dysfunction resulting in death. Various risk factors were identified to be associated with the severe form of COVID-19 such as gender (male), and age (older individuals) [7-9]. However, numerous COVID-19 patients without such risk factors may present a severe form of COVID-19 infection. In this regard, the quest for a prognostic factor of COVID-19 infection is still ongoing.

Blood types are among the parameters that may be associated with the severity of the COVID-19 infection [10-12]. Among blood groups, the ABO blood group system is conceivably the most important blood group system in clinical practice [13]. ABO antigens comprise glycoprotein and glycolipid molecules that can be found on the surface of cells, and in the secretions of body fluids in some individuals [13, 14]. The frequency of the A, O, B, and AB among Iranian blood donors are identified as 30.25, 37.62, 24.36, and 7.77%, respectively [15]. Antigens of this system are thought to modulate the spread of pathogens through natural antibodies and the complement system [13, 14].

Several studies have reported the association between COVID-19 infection and the blood group system [10, 12-14]. In this regard, preliminary studies have shown that some ABO blood groups may predispose individuals to COVID-19 infection and may predict the severity of the disease [11, 13, 14]. However, their findings are still contradictory [16, 17]. For instance, some study by demonstrated that people with blood type A were more likely to develop COVID-19 infection than those with other blood groups. Furthermore, they observed that people with the O blood group are less likely to get COVID-19 infection in comparison with other blood types [18]. In another study, Goker *et al.* investigated the association between ABO antigens and COVID-19 infection. They observed that A and O blood groups were the most common blood types in patients with COVID-19, respectively [19]. Nevertheless, another study indicated that individuals with the AB blood group were more likely to develop COVID-19 infection [18, 19].

Considering the various distribution of ABO blood types in different geographical regions, ethnic groups, and races, the present study aimed to investigate the association of ABO blood group with the risk of COVID-19 infection, its hematology findings and mortality.

Instrument and Methods

This cross-sectional descriptive study was conducted in all patients referred to Shahid Jalil Hospital in Yasuj city, southwest Iran, due to the possibility of infection with COVID-19 from May to October 2021. Totally, 182 patients were recruited using the census method. The diagnosis of COVID-19 was according to CT and real-time polymerase chain reaction (RT-PCR). People with CT, RT-PCR, and general symptoms of COVID-19 were included in the study. Samples were classified into two groups in terms of COVID-19 infection; positive (n=104) and negative (n=78).

The demographic information and laboratory findings of patients (age, days of staying in hospital, complete blood count, lymphocyte count, neutrophil count, and ESR) were recorded.

The consent form was signed by patients or their legal guardians. Confidentiality of information and others ethical considerations based on the relevant guidelines and regulations in accordance with the Declaration of Helsinki was considered. The patients were not charged for research tests. Three ml of venous blood was collected from each patient for blood group tests. The ABO blood groups of participants were detected using conventional methods (cell-typing and back-typing).

Data were analyzed using Chi-Square, independent T (relationships between COVID-19 negative and positive groups), and one-way-ANOVA (analysis of demographic and hematological parameters between different ABO phenotypes of COVID-19 positive patients) tests in SPSS 21 software.

Findings

104 cases (57.1%) of the studied population were COVID-19 positive and 78 cases (42.9%) were negative. Seventy cases (38.5%) were women and the ratio of men to women was 1.59:1. In positive group, 67 samples (64.4%) were male and 37 samples (35.6%) were female and in negative group, 45 samples (57.7%) were men and 33 samples (42.3%) were women. The mean age of positive group was 44.1±20.2 and negative group was 41.4±17.7 years (p=0.35). 77 of hospitalized patients (92.8%) were discharged in good condition and 6 (7.2%) passed away during the hospitalization.

The ESR, red cell distribution width (RDW), and mean corpuscular hemoglobin concentration (MCHC) were significantly different between the COVID-19 negative and positive groups ($p<0.05$; Table 1).

Table1. Comparison of complete blood count parameters and erythrocyte sedimentation rate between the COVID-19 positive and negative groups by independent T-test

Parameter	Positive	Negative	p-Value
White Blood Cell (WBC)	6.92±2.90	6.80±2.20	0.755
Red Blood Cell (RBC)	4.97±0.61	5.16±0.79	0.064
Hemoglobin (Hb)	14.66±1.96	14.82±1.83	0.574
Hematocrit (Hct)	43.67±6.10	44.85±5.50	0.184
Mean Corpuscular Volume (MCV)	87.60±6.80	87.22±8.70	0.739
Mean Corpuscular Hemoglobin (MCH)	29.43±2.30	28.90±3.40	0.218
Mean Corpuscular Hemoglobin Concentration (MCHC)	33.62±1.30	33.12±1.30	0.017
Platelets count	211.7±67.0	220.6±55.0	0.342
Red Cell Distribution Width (RDW)	12.13±1.00	12.51±1.40	0.037
Neutrophil count	64.1±17.0	59.6±12.0	0.052
Lymphocyte count	32.1±16.0	35.8±11.3	0.066
Erythrocyte Sedimentation Rate (ESR)	25.3±20.6	13.5±10.7	<0.001

Table 2. Association of the mean of CBC parameters and erythrocyte sedimentation rate according to the ABO blood types in the COVID-19 positive group by one-way ANOVA

Parameter		Mean±SD	p-Value
White Blood Cell (WBC)	A	7.37±3.32	0.481
	B	6.83±3.22	
	O	6.74±2.51	
	AB	5.13±1.23	
Red Blood Cell (RBC)	A	4.91±0.51	0.314
	B	5.18±0.53	
	O	4.91±0.74	
	AB	4.89±0.61	
Hemoglobin (Hb)	A	14.57±1.35	0.338
	B	15.29±2.11	
	O	14.37±2.28	
	AB	14.55±2.52	
Hematocrit (Hct)	A	43.01±4.51	0.271
	B	45.85±5.94	
	O	43.00±7.21	
	AB	43.33±8.51	
Mean Corpuscular Volume (MCV)	A	87.01±5.47	0.843
	B	88.64±9.10	
	O	87.54±6.47	
	AB	87.50±6.85	
Mean Corpuscular Hemoglobin (MCH)	A	29.51±1.78	0.942
	B	29.60±3.36	
	O	29.25±2.34	
	AB	29.53±1.82	
Mean Corpuscular Hemoglobin Concentration (MCHC)	A	33.92±1.46	0.345
	B	33.34±1.05	
	O	33.49±1.38	
	AB	33.70±1.37	
Platelets count	A	211.57±60.63	0.831
	B	221.96±88.96	
	O	206.62±60.60	
	AB	200.00±62.79	
Red Cell Distribution Width (RDW)	A	12.19±1.16	0.482
	B	11.94±0.63	
	O	12.25±1.10	
	AB	11.63±0.42	
Neutrophil count	A	65.70±14.80	0.229
	B	64.08±14.07	
	O	64.41±20.42	
	AB	46.75±21.59	
Lymphocyte count	A	30.38±13.74	0.179
	B	32.21±12.96	
	O	31.79±18.61	
	AB	49.00±20.85	
Erythrocyte Sedimentation Rate (ESR)	A	27.51±22.02	0.529
	B	22.70±19.43	
	O	26.00±20.95	
	AB	13.00±9.27	

The frequency of the A, O, B, and AB blood types were 37.5, 35.6, 23.1, and 3.9%, respectively in the positive and were 35.9, 46.2, 14.1, and 3.9%, respectively in the negative groups (p>0.05). There was no statistical relationship between ABO blood groups and mortality rate in COVID-19 patients (p>0.05).

There were no significant differences in ABO blood types between the COVID-19 positive and negative groups according to gender (p=0.148). There was no significant association between the ABO blood group phenotypes and the mean of demographic and laboratory information in the COVID-19 positive patients (p>0.05; Table 2).

Discussion

The ABO blood group as a blood group system with the most immunogenic antigens has been related to various infections such as *H. pylori*, *Plasmodium falciparum*, and hepatitis B [20, 21]. Blood group-associated antigens may act as receptors and/or co-receptors for microorganisms, and aid their invasion into the host cells. On the other hand, ABO blood group antigens play crucial roles in the innate immune system [22]. Consequently, the ABO blood group is assumed to be in charge of individuals' susceptibility to different pathogens. In this regard, the association between SARS-COV-2 and the ABO blood groups is still unknown, and the findings of preliminary studies are controversial. In a bid to determine the association of ABO blood groups with COVID-19 infection, we conducted a cross-sectional study in southwestern Iran.

Our results showed that the frequency of the A, O, B, and AB in the COVID-19-positive group was 37.5%, 35.6%, 23.1%, and 3.85% respectively. Although, the frequency of A in the COVID-19-positive group was higher than the national and provincial ABO blood group distribution there is no significant association between ABO blood type and susceptibility to COVID-19 infection [15]. Our study's findings are compatible with other studies [23, 24]. One study by Ryan L. Hoiland *et al.* reported, ABO blood group distributions did not differ from their general population [23]. Furthermore, Khalil A *et al.* showed that although the A blood group was the most common blood group among the COVID-19 group, considering the distribution of blood groups among the control groups, this relationship lost its significance [25]. As well as Domenech-Montoliu S, *et al.* suggested that the ABO blood group had not a significant effect on the incidence of COVID-19 infection [26].

Contrary to our study, most studies have demonstrated that individuals with blood group A were more likely to develop COVID-19 infection, while those with blood group O had a lower risk of COVID-19 infection [18, 27, 28]. For example, GÖKER *et al.* showed Group A was more prevalent in COVID-19 patients compared to controls and group O was less

prevalent in patients [19]. Solmaz *et al.*, Aktimur *et al.*, and Wu *et al.* determined the same results [22, 29, 30].

However, fewer studies reported an increased proportion of patients with blood group B or AB [18, 31]. For example, Ray JC, *et al.* reported group AB was more prevalent in COVID patients compared to controls and group O was less prevalent in patients [32]. Latz *et al.*, distinguished Groups A, B, and AB were more prevalent in COVID–19 patients compared to Group O. However, Matzhold *et al.* reported group AB was more prevalent in COVID patients compared to controls [33].

These contradictory findings may be due to the disproportionate impacts of COVID-19 infection on racial and ethnic minorities and the reported ABO distribution is due to the variation of ABO blood groups among various ethnic and races. Moreover, sample size, the type of studies, and the control group can affect the results of the studies.

Furthermore, our study showed that there was no meaningful association between the ABO blood group phenotype and the mean of hematology findings and mortality rate in the COVID-19 positive patients. These results are consistent with several previous reports [30, 34, 35]. Behboudi *et al.* showed there is no significant difference in the mortality of COVID-19 patients [36].

As for COVID-19 disease mortality and ABO blood group, some studies demonstrated no statistically significant correlations whereas a number of studies reported increased mortality in type A patients [10, 18, 37, 38]. Namely, Sarud *et al.* announced increased mortality in non-O blood types [39]. Whiles Halim *et al.* pointed out that mortality and the need for mechanical ventilation increased in blood group A compared to other groups [40]. These results were conflicting and a definitive association of the ABO blood group distribution with mortality or severity outcomes remains to be proven.

The most important limitation of the current study was the non-cooperation of suspected COVID-19 people, which did not allow the study to be conducted with a larger population. It is suggested that due to the outbreak of this disease in many parts of the world, this study should be done in multicenter and with numerous cases and even with different races to confirm or reject this theory definitively. further studies on a larger sample size and investigation the relationship between COVID 19 and other blood groups are recommended.

Conclusion

There is no association between ABO blood groups and COVID-19 infection and its mortality.

Acknowledgments: We would like to thank the staff of Shahid Jalil Hospital in Yasuj for their assistance with the collection of our data.

Ethical Permissions: The current study was approved by the ethics committee of Yasuj University of Medical Sciences (IR.YUMS.REC.1399.43).

Conflicts of Interests: Authors declare that there is no conflict of interest.

Authors' Contribution: Etemadfar P (First Author), Main Researcher/Discussion Writer (15%); Rad F (Second Author), Introduction Writer/Methodologist/Main Researcher/Statistical Analyst/Discussion Writer (45%); Rostami Yasuj Sh (Third Author), Main Researcher (10%); Fakhari Gh (Fourth Author), Assistant Researcher (7%); Esmaeili OS (Fifth Author), Assistant Researcher (7%); Niazkar HR (Sixth Author), Introduction Writer (9%); Ghatee MA (Seventh Author), Statistical Analyst (7%)

Funding/Support: Deputy of research of Yasuj University of Medical Sciences supported this study.

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