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Relationship between Blood Groups and the Risk of Covid-19 Infection; a Cohort Study

Mohamad Mahjoor [1±], Abolfazl Askari [2±], Mansoor Khaledi [2], Hamed Afkhami [3], Hamed Sadeghi-Dehsahraei [4], Javad Arabpour [5, 6], Javad Fathi [7], Amir Valizadeh [8], Mohammad Esmaeil Amini [9], Mohammad Esmkhani [10], Reza Safarinia [11], Zahra Mottaghiyan [3*]*

1 Department of Immunology, Faculty of Medicine, Iran University of Medical Sciences, Tehran, Iran.

2 Cellular and Molecular Research Center, Basic Health Sciences Institute, Shahrekord University of Medical Sciences, Shahrekord, Iran.

3 Department of Microbiology, Faculty of Medicine, Shahed University, Tehran, Iran.

4 Department of Basic Sciences, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.

5 Young Researchers and Elite Club, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.

6 Department of Microbiology, Faculty of Advanced Sciences and Technologies, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.

7 Department of Bacteriology and Virology, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.

8 Molecular Medicine Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

9 Department of Microbiology, school of Medicine, Guilan University of Medical Science, Rasht, Iran.

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ABSTRACT

Background: ABO blood types are not known to cause diseases directly, but they can be vulnerable and surrender to diseases and health problems. This study aimed to evaluate the susceptibility to COVID-19 in individuals with different blood groups at different ages.

Methods: An electronic health record was used in this retrospective cohort study at Shahid Beheshti Hospital. We studied 858 patients who were referred to Shahid Beheshti Hospital, we identified 434 of them as COVID-19 patients using RT-PCR. An analysis of the electronic record involved collecting retrospective laboratory data and demographic information, including age, sex, and blood type. Next, we examined the differences between the ABO blood groups of COVID-19 patients and the control group (1991 case). We used SPSS26 for statistical computations. Data were scrutinizeed with the $\chi 2$ test. $P < 0.05$ was considered statistically outstanding.

Results: Based on the distribution of ABO blood groups in 434 COVID-19 patients, it was revealed that 288 of them were male and 146 were female, and the majority of them were in their third decade of life. A total of 159 patients (36.6%) had type B blood, 116 had type A (26.7%), 109 had type O (25.1%), and 50 had type AB (11.5%). COVID-19 patients had a higher percentage of type B and AB blood than the control group.

*Corresponding Authors:

Reza Safarinia, Department of Microbiology, Shahrekord Branch, Islamic Azad University, Shahrekord, Iran.

Tel: +98-21-51212644, *E-mail:* university.ac33@yahoo.com

Zahra Mottaghiyan, Department of Microbiology, Faculty of Medicine, Shahed University, Tehran, Iran.

Tel: +98-21-51212644, *E-mail:* university.ac55@yahoo.com

± Mohamad Mahjoor and Abolfazl Askari are both co-first authors.

Conclusion: Our study found that the frequency ratio of blood group B was remarkably higher in patients than in the control group, which indicates that the blood group B may play a pivotal role in COVID-19 disease.

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Introduction

COVID-19 disease is begot by a new beta-coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (1, 2). COVID-19 was first reported in December 2019, when several patients with pneumonia of unknown cause were identified in Wuhan, China (3).

Since the first COVID-19 patient registration, the emergence of the new SARS-CoV-2 virus has resulted in 4.8 million deaths among approximately 240 million patients with the disease worldwide. It has created an unprecedented crisis in modern times (4, 5).

In general, risk factors include variables associated with increased incidence and severity of infection or disease (6, 7), divided into immutable risk factors and modifiable risk factors (8, 9). Blood type and age are in the first category, and other factors such as uncontrolled diseases are in the second group.

The clinical manifestations of Covid-19 disease vary from person to person, ranging from the common cold to more severe illnesses such as bronchitis, pneumonia, severe acute respiratory distress syndrome (ARDS), multiple organ failure, and even death (3, 5, 10). Underlying diseases often increase the risk and severity of various diseases, and Covid-19 is not exempt from this rule. According to multiple observations, factors such as high age (11-21), cardiovascular disease (11, 13, 19, 22), diabetes (11, 18, 19, 21-24), and hypertension (13, 15, 19, 21, 22, 24, 25) increase the risk and severity of the disease among COVID-19 patients.

In ABO blood group classification, red blood cell surface antigens determine a person's blood type, and they are divided into blood groups A, B, O, or AB. Rhesus (Rh) factor protein also determines whether a blood type is positive or negative (26). Blood types have always been one of the most critical factors in viral and bacterial diseases (9, 27). Scientists have previously researched the relationship between viral respiratory diseases such as H1N1 and SARS and different blood types in the SARS epidemic (9, 28-30).

The purpose of this review is to investigate the impact blood groups on the incidence of COVID-19 at different ages.

Materials and Methods

Data Resources and Population

This retrospective cohort study was performed at Shahid Beheshti Hospital using abstract data from an electronic health record. The hospital provides tertiary services to a large population, and its bed capacity and intensive care services have been increased in anticipation of an increase in COVID-19.

The study population consisted of 858 people referred to Shahid Beheshti Hospital, and 434 of them were identified as COVID-19 patients by RT-PCR method .

Clinical and Laboratory Data

Retrospective laboratory data and demographic information, including age, sex, Blood typing were collected from the electronic record for analysis.

Blood Group Data

ABO blood groups were recorded and collected from patients' electronic records, and the

differences in the distribution of ABO blood groups amidst COVID-19 patients and the control group (1991 case) were analyzed. The relationship between the blood group and clinical features was interpreted.

SARS-CoV-2 Test

We used diagnostic PCR to identify COVID-19 patients, as this method often detects 2 to 3 genes and has a rapid diagnostic advantage. However, since SARS-COV-2 is commonly mutated, there is a possibility of a false negative in this method.

Diagnosis of COVID-19 using PCR does not clearly determine whether the virus is positive or negative, and the diagnosis is based on the value of the Threshold Cycle (Ct). Cycle threshold values (Ct) in RT-PCR are inversely related to viral load and used to measure the amplification required for the target viral gene (31, 32).

In our study, we also used CT as a diagnostic criterion for Covid-19, although, in the early stages of the disease, when the target gene is low or swab sampling is not done well, it can lead to a false-negative result.

Statistical Analysis

Statistical computations were performed using SPSS26. Data were analyzed with the $\chi 2$ test. $P < 0.05$ was considered statistically notable.

Result

The ABO blood group distribution of 434 patients with COVID-19 defined that 288 were male and 146 were female, the mean age of the patients were 37.79 ; the lowest age was 2 years and the highest one was 84 years and the most of the patients were in the third decade of their lives. there were 159 patients with type O blood (36.6%) , 116 patients with type A (26.7%), 109 patients with type B (25.1%), and 50 patients with type AB (11.5%) . Comparision of the blood types showed, type O was the most common, and type AB was the least common (Table 1). The COVID-19 patient group contained higher percentages of individuals with type B and AB blood than the control group.

In most of age groups of patients, the frequency of blood groups are similar to the overall result. But in the second and fourth decades of the age groups, The B blood group in patients was more than A blood group . Also, in the sixth and seventh decades, patients with blood group A were more than patients with blood group O.

Considering that in our study, the frequency ratio of blood group B in patients is higher than this ratio in the control group, it seems that blood group B is a risk factor for COVID-19 disease.

Discussion

Blood groups are a system include a set of antigens that are found on red blood cells (RBCs). They are characterized by several genes which may be allelic or closely linked to the same chromosome. According to this definition, Blood Type refers to a unique reaction pattern to testing antibodies in a given system (33).

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ABO is one of the most famous blood group systems, including antigens A and B and their corresponding antibodies, which is the basis for the ABO blood group system. Alleles A, B, and O are located on chromosome 9q34.1-34.2 and cause four genetic phenotypes (blood groups AB, O, A, and B) (34-36).

Table 1. The percentage of blood groups in COVID19 patients and Control group.

Blood groups	COVID19 patients (count (%))	Control group (count (%))
A	116 (26.7%)	138 (32.55%)
B	109 (25.1%)	98 (23.11%)
AB	50 (11.5%)	28 (6.60%)
O	159 (36.6%)	160 (37.74%)
Total	434	424

Table 2. The percentage of blood groups in each age group.

Age (years)	BG (count (%))			
	A	B	AB	O
0-10	1 (25%)	0 (0%)	0 (0%)	3 (75%)
B11-20	6 (18.2%)	7 (21.2%)	6 (18.2%)	14 (42.4%)
21-30	35 (28.2%)	32 (25.8%)	12 (9.7%)	45 (36.3%)
31-40	28 (23.3%)	31 (25.8%)	17 (14.2%)	44 (36.7%)
41-50	17 (26.2%)	15 (23.1)	5 (7.7%)	28 (43.1%)
51-60	16 (34.8%)	13 (28.3%)	7 (15.2%)	10 (21.7%)
61-70	10 (37%)	7 (25.9%)	2 (7.4%)	8 (29.6%)
71-80	1 (9.1%)	2 (18.2%)	1 (9.1%)	7 (63.6%)
81-90	2 (50%)	2 (50%)	0 (0%)	0 (0%)
Total	116(26.7%)	109(25.1%)	50 (11.5%)	159(36.6%)

Karl Landsteiner discovered the ABO blood types system as the first human blood types in 1900 (37, 38). There has always been research on the correlation between this blood type and a variety of diseases due to its inherent nature in every human and the ease of diagnosis (39).

A host's susceptibility to infection can be affected by blood group antigen expression variations. Bacteria, parasites, and viruses can be transmitted by blood group antigens that act as coreceptors and receptors. Through the formation of membrane microdomains, many antigens of blood groups facilitate intracellular uptake, signal transduction, or cell adhesion. Moreover, they appear to modulate innate immunity (27, 36).

Researchers have discovered that people's blood type does not cause disease, but it can increase their risk of becoming ill. There is generally a higher risk of disease in non-O blood groups than in O blood groups (40).

Statistically or biologically, ABO blood groups are associated with chronic diseases like tumourigenesis, coronary heart disease, and vascular disease (41). Over the years, research into the relationship between some viral infections and ABO blood types has caught everyone's attention. Identifying an individual's vulnerability to a virus may be achieved by analyzing the contribution of different blood groups to viral infection.

Past studies have shown a relationship between ABO blood types and susceptibility to infectious diseases such as hepatitis B virus (41), Helicobacter pylori (42), Norwalk virus (43), and SARS-CoV (28).

Studies during the Coronavirus Acute Respiratory Syndrome (SARS-CoV) epidemic

have shown that ABO blood type may play a role in the disease, and it has been shown that people with blood type O are less susceptible to SARS-CoV infection (28, 44). Similar studies have shown blood types A and B in H1N1 (29) patients and blood type B in H3N2 (30) patients are also susceptible to infection.

The proximity of the SARS-CoV and SARS-CoV-2 viruses (45) and the cohesion between the ABO and SARS-CoV blood groups directly suggested a similar susceptibility to COVID-19 (39).

Most studies identified a higher proportion of group A, and a lower proportion of group O, among COVID-19 patients, as compared to healthy controls (9, 25, 36, 46-51).

In 2008, research was conducted to investigate the association of blood groups and the risk of SARS-CoV infection, suggesting that modulation of the interplay between the virus and host cells may be due to natural anti-A antibodies. Monoclonal or natural human anti-A antibodies inhibited protein / ACE2-dependent adhesion to ACE2-expressing cell lines in the cell model. Therefore, because of the inhibitory effects of anti-A antibodies, people with non-A blood groups, especially blood groups O and B, might be less likely to get SARS-CoV-2 (9, 52, 53). Nevertheless, our observations in this population proved otherwise for various reasons.

According to our analysis of the age of 434 patients and the blood types of those with SARS-CoV-2 infection in the second and fourth decades, B blood groups were more frequently detected than A blood groups in patients in the second and fourth decades. Similarly, more patients with blood group A than those with blood group O in the sixth and seventh decades.

Our results showed that the frequency ratio of type B blood in patients was higher than this ratio of type A blood in controls and suggested that type B blood may be a risk factor for infection with SARS-CoV-2. Furthermore, further research will be needed to determine the ABO blood groups and their relationship to various diseases, especially COVID-19.

Conclusion

COVID-19 infection is associated with different risks for different ABO blood groups. People with blood type B may be at higher risk for infection and need more careful monitoring and more aggressive treatment. Additional studies, including those involving ABO subgroups, will be necessary for an in-depth understanding of the relationship between COVID-19 and ABO types.

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Ethics approval and consent to participate

Adherence to the Principles of Research Ethics Principles of ethics in the writing of the article, according to the COPE guidelines observed by the World Ethics Committee and the Rules of Procedure.

Conflict of interest

The authors declare that they have no conflict of interest.

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