

Relationship between ABO Blood Group with Severity, Length of Hospitalization, and Mortality Rate of COVID-19 Patients

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ABSTRACT

Previous research suggests that the ABO blood group may play a role in the immunopathogenesis of SARS-CoV-2 virus infection. The purpose of this study was to analyze the relationship between the ABO blood group and the severity, length of hospitalization, and mortality rate of COVID-19. A descriptive-analytic study with a cohort retrospective design, involving 257 research samples, was conducted. The statistical tests used in this research were the Kolmogorov-Smirnov test, the Chi-Square test, the Fisher Exact test, and the Kruskal-Wallis test. The test results were significant if the p-value <0.05. From the results of the study, it was found that the analysis of blood type with severity was not statistically significant ($p > 0.05$), as well as blood type with severity and length of treatment, there was no relationship between severity and length of stay in all blood groups (all with $p > 0.05$) while for blood groups with severity and mortality, there was a relationship between blood type and high mortality in all blood groups (all with $p < 0.001$). There was no relationship between blood type and severity of SARS-CoV-2 virus infection (all $p > 0.05$). However, there was a significant relationship between criticality and high mortality in all blood groups (all with $p < 0.001$). Pathophysiological mechanisms that explain the relationship between ABO blood type and SARS-CoV-2 infection, one of which is the presence of anti-A antibodies in group O individuals that bind to the A antigen in the viral envelope and block infection, in which blood group O has susceptibility to SARS virus infection. There is no relationship between ABO blood type and patient severity and length of stay, but there is a correlation between mortality and ABO blood type in COVID-19 patients.

Keywords: COVID-19 patients, ABO blood group, the severity of infection, the mortality rate

INTRODUCTION

A previous study about the relationship between an infectious agent with the human blood type showed that blood-type antigens found on the surface of the erythrocyte interact with microorganisms such as bacteria, viruses, parasites, and fungi.¹ According to the World Blood Transfusion Association, at least 341 antigens have been identified and categorized into 41 blood type systems. There are 13 ABO blood type systems, such as that have been found by Landsteiner, which are the most important blood types.¹⁻³

The mechanism of blood-type antigens causing susceptibility or protection towards infectious agents or affecting disease evolution has not been clarified. There is some underlying evidence suggesting that blood group antigens may act as receptors and/or cofactors for several infectious agents including Norwalk virus and *Helicobacter pylori*, interacting with ABO antigens to bind to the

gastric mucosa, therefore, natural antibodies against ABO antigens can act as part of innate immunity that can weaken infections. Other studies also show that ABO blood type may have a role in the immunopathogenesis of SARS-CoV-2 viral infection. Individuals with non-O blood type were found to have a higher risk of being infected by the SARS-CoV-2 virus.⁴⁻⁶

The relationship between blood type and Coronavirus infection has been studied in 2005 by Cheng *et al.* studied the relationship between ABO blood type and risk of SARS-CoV infection in 45 medical staff who didn't use protective gear when exposed to a patient infected with SARS-CoV. This study reported that individuals with an O blood type have a lower infection risk compared to non-O blood types.⁶

Another study by Ray *et al.* in 225,556 COVID-19 cases, reported that O blood type and Rh negative had a lower risk of COVID-19 severity and mortality compared to other blood types. Systematical and

meta-analysis of 5 studies found that A blood type has a statistically significant higher risk of death due to SARS-CoV-1.^{7,8}

This study aimed to analyze the correlation between blood type with COVID-19 severity, length of hospitalization, and mortality.

METHODS

This was an analytic descriptive study using a cohort retrospective design. The research was conducted at the Medical Record Installation of Dr. Wahidin Sudirohusodo Hospital, Makassar in October 2021 by taking medical record data from July 2020 to September 2021. The study population was all patients who were confirmed positive for COVID-19 and were being treated at Dr. Wahidin Sudirohusodo Hospital who met the inclusion criteria, namely aged 18 to 60 years, and had data on the results of an ABO blood type examination. Patients who had blood group discrepancy results in ABO blood group examination were excluded from this study.

Research permission was obtained from the Health Research Ethics Commission, Faculty of Medicine, Hasanuddin University/Dr. Wahidin Sudirohusodo Hospital with number 701/UN4.6.4.5.31/PP36/2021. Analysis of the data obtained was processed by statistical tests, using SPSS software.

RESULTS AND DISCUSSIONS

A total of 1020 patients confirmed positive for COVID-19 were being treated at Dr. Wahidin Sudirohusodo Hospital during the study period, and 257 met the inclusion criteria (Table 1).

Table 1. Characteristics of the research sample and distribution of blood group

Criteria	Total (n=257)
Gender	
Male	114 (44.4%)
Female	143 (55.6%)
Age	
18–25 years old	22 (8.6%)
26–35 years old	54 (21%)
36–45 years old	64 (21%)
46–55 years old	77 (30%)
>55 years old	40 (15.6%)
Blood type	
A	79 (30.7%)
B	61 (23.7%)
AB	22 (8.6%)
O	95 (37%)
Outcome	
Recovered	212 (82.5%)
Died	45 (17.5%)

*Chi-Square test

Table 2 describes the analysis of blood groups with degrees of severity. The highest percentage of critical degrees was found in blood group AB (22.7%), severe degrees in blood group O (10.5%), and moderate degrees in blood group A (84.8%), but all were not statistically significant ($p > 0.05$).

Table 3 illustrates the relationship between blood group, severity, and duration of treatment. There was no significant relationship between the degree of severity and length of stay for all blood groups (all with $p > 0.05$).

The research was conducted at Dr. Wahidin Sudirohusodo Hospital in October 2021 by taking data from medical records from July 2020 to September 2021, obtaining data from 257 patients

Table 2. Relationship between blood group and COVID-19 severity

Blood group		Severity			*p
		Moderate	Severe	Critical	
A	n	67	5	7	0.518
	%	84.8%	6.3%	8.9%	
B	n	50	6	5	
	%	82.0%	9.8%	8.2%	
AB	n	15	2	5	
	%	68.2%	9.1%	22.7%	
O	n	75	10	10	
	%	78.9%	10.5%	10.5%	
Total	n	207	23	27	
	%	80.5%	8.9%	10.5%	

*Chi-Square test ($p=0.5128$)

Table 3. Relationship between blood group and severity and length of treatment

Blood Group	Severity		Length of Stay Category		*p
			≤ 10 days	≥10 days	
A	Moderate	n	39	28	0.366
		%	15.1%	10.89%	
	Severe	n	3	2	
		%	1.16%	0.78%	
	Critical	n	6	1	
		%	2.33%	0.4%	
B	Moderate	n	27	23	0.387
		%	10.5%	8.9%	
	Severe	n	5	1	
		%	1.94%	0.4%	
	Critical	n	3	2	
		%	1.16%	0.78%	
AB	Moderate	n	11	4	0.372
		%	4.3%	1.55%	
	Severe	n	1	1	
		%	0.4%	0.4%	
	Critical	n	2	3	
		%	0.78%	1.16%	
O	Moderate	n	42	33	0.306
		%	16.3%	12.8%	
	Severe	n	5	5	
		%	1.94%	1.94%	
	Critical	n	8	2	
		%	3.11%	0.78%	

*Chi-Square test

who met the inclusion criteria. The characteristics of the research sample found that there were more females (55.6%) than males (44.4%). The results obtained from the distribution of blood groups in this study sample showed that there was more O blood type (37%) compared to A, B, and AB blood groups.

The results of the blood group analysis with the degree of severity show that the group A blood type had more moderate degree patients compared to the other blood groups. Meanwhile, blood type O had more severe patients than the other blood groups. Blood group AB had a higher number of patients in the critical degree compared to blood groups A, B, and O. These were all not statistically significant, showing that there is no relationship between blood type and the severity of SARS-CoV-2 virus infection ($p > 0.05$). This is in line with research conducted by Kumara *et al.*, blood type (blood groups A and O) have no relationship/relationship with increased severity or mortality in the hospital.⁹ However, this study found a significant relationship between the degree of illness with high mortality in all blood groups ($p < 0.001$).

During the SARS-CoV-2 virus infection pandemic, several studies found that the ABO blood group could cause various diseases, with lower susceptibility in O blood group individuals.⁷ Most studies identified a higher proportion of patients infected with COVID-19 and a longer risk of hospitalization from the A blood group.¹⁰⁻¹²

Several pathophysiological mechanisms have been proposed to explain the relationship between the ABO blood group and SARS-CoV-2 infection, one of which is the presence of anti-A antibodies in group O individuals, which bind to antigen A in the viral envelope, blocking infection. It can be concluded that blood type O has susceptibility to infection with the SARS-CoV-2 virus.^{13,14} There were 95 out of the 257 subjects infected with COVID-19 in this study with the O blood group, which was the highest number of patients compared with the other blood groups, but no significant relationship was found for the degree of severity with all blood groups.

There is also evidence that the Receptor Binding Protein (RBD) of the SARS CoV-2 virus binds to blood group antigens. Receptor-binding protein binds to

blood group A, which is expressed in respiratory epithelial cells. Several research results found that blood group A has a higher risk of infection with the SARS-CoV-2 virus and a longer length of hospitalization.¹⁴ This is in contrast with this study that reported blood group O had a higher risk of infection, longer hospitalization, and higher mortality rates, this might be due to the age and gender difference of the study population. As a meta-analysis study linking type of gender with the risk of COVID-19 infection, it is known that males are 28% more at risk of infection compared to females. Studies also report a relationship between gender and mortality, which shows that male patients have a 1.86% more risk of dying compared to females.¹⁵ There is a relationship between age and the level of innate immunity, where older individuals are more likely to be infected along with decreased innate immunity. In addition, elderly individuals have consumed a lot of drugs or consumed several types of drugs at the same time to treat comorbidities, which resulted in decreased organ function.^{16,17}

The limitations of this study are the uneven distribution of the sample in age and gender categories. Several previous studies have found that there is a relationship between ABO blood type and COVID-19 infection, namely blood type O has a lower risk of infection compared to the non-O blood group, and blood type A has a higher risk of infection, length of stay, and mortality. However, there was no significant relationship found in this study.

CONCLUSIONS AND SUGGESTIONS

According to this study, there is no relationship between ABO blood type and degree of severity or hospitalization duration in COVID-19 patients, but there is a correlation between severity and high mortality in all blood types of COVID-19 patients. Researchers need broader characteristic data for further research.

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