Original Article

Impact of ABO Blood Group, Hematological, and Biochemical Abnormalities on Incidence of Patients Infected with COVID-19

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ABSTRACT

This study aimed to investigate the relationship between blood types and COVID-19 susceptibility and explore changes in blood variables, as well as their relationship with the occurrence of COVID-19. SARS-CoV-2 is a pandemic that has affected people's health and the global financial system. Since the initial confirmed case of COVID-19, people have been influenced worldwide with varying manifestations. Moreover, researchers have illustrated a link between ABO blood types and COVID-19 susceptibility and incidence. Research has also shown that ABO blood groups might play a role in estimating COVID-19 susceptibility and death. Our analysis revealed that blood type O might probably reduce vulnerability to the SARS-CoV-2 illness. On the contrary, people with blood type A are at a higher risk of SARS-CoV-2 infection. This study also evaluated liver biomarkers among COVID-19 patients, revealing significant abnormalities in the levels of alanine amino transferees, aspartate amino transferees, gamma-glutamyl transferees, and total bilirubin.

Keywords: Blood cells, COVID-19, Enzymes, Infection, Liver tests, Virus

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1. Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. The first incident of COVID-19 was discovered in Wuhan, China, in December 2019. The illness rapidly spread across the globe, resulting in the COVID-19 pandemic (1). Several studies have found a link between ABO blood groups and COVID-19 vulnerability and intensity (2). Gerard, Maggipinto (3) investigated whether humans with B and/or O blood types are less likely to have COVID-19, highlighting the hopeful beneficial role of anti-A antibodies in COVID-19 susceptibility. Previous studies have investigated the correlation between the pathogens of a living person and blood types (4, 5). It was evidenced that blood-type virulence factors are produced by red blood cells (RBCs), while other tissues collaborate with MOs, such as bacteria and viruses. Furthermore, variations in blood type antigen presentation could indeed increase or reduce presenter vulnerability to several pathogens, which might directly contribute to the virus by trying to act as a transcription factor and/or a founder for microbes (4-7). Moreover, Guillon, Clement (8) discovered that anti-histo-blood group immune globulins suppress interaction for both the SARS-CoV-2 spike nutrients and their cell receptors.

Clinical and biochemical characteristics are critical in COVID-19 diagnosis. Multiple genetic variants, such as an increased complete blood count (CBC), have been a reliable tool in identifying a variety of viral infections, such as COVID-19. Moreover, conditions such as leukocytosis, lymphopenia, and neutrophil can also contribute to the diagnosis of COVID-19 (9).

CBCs are extremely useful for experimental investigations because of their grade variations, which allow the identification of clinical features. Moreover, they are a primary showcase for sharing data, as well as a primary marker for showing proof for assessment and monitoring.

COVID-19 also indicates a changeable rating of liver failure, with unusual alanine amino transferees (ALT), aspartate amino transferees (AST), and total bilirubin (TB) levels, in addition to enhanced gamma-glutamyl transferees (GGT) (10). Liver biologies, such as ALT, AST, and GGT, are unhinged in COVID-19 patients with liver injury, liver fibrosis, and a serious harm. As a result, there is an increase in serum AST and ALT levels in the early stages of the disease, a biliary tract template that evolves as the infection progresses and induces elevated doses of GGT as a marker of biliary tract harm, and an elevated serum level judging the secretion ability (11).

Abbreviations: ALT: Alanine Amino Transferees; AST: Aspartate Amino Transferees; GGT: Gamma Glutamyl Transferees; CBC: Complete Blood Count; Hb: Hemoglobin; PLT: Platelets; RBCs: Red Blood Cells; WBCs: White Blood Cells.

2. Materials and Methods

This study was conducted on COVID-19 patients referred to Al-Yarmuk Teaching Hospital, Baghdad, Iraq, from December 1, 2021, to February 28, 2022.

A total of 171 patients were selected for this study based on their positive results in RT-PCR testing. Data were collected from patients, recorded, evaluated, and compared to the healthy controls.

The data were statistically analyzed to clarify the impact of various variables in the research, according to the SAS (12). Throughout this research, an independent sample t-test was used to compare groups and determine significant differences.

3. Results

This study examined ABO and Rh blood types in relation to COVID-19 vulnerability. In total, 171 COVID-19 patients were selected based on their positive RT-PCR test results.

Based on the findings, 75 (43.85%) patients were blood type A, 50 (29.23%) were blood type B, 38 (22.22%) were blood type O, and 8 (4.67%) were blood type AB, as shown in table 1.

According to the results, blood type A constituted the most common blood type in many participants, followed by B, O, and AB types (Table 1).

COVID-19 patients were also categorized based on their gender, as shown in table 2. The male category comprised 94 out of 171 patients. The frequency of ABO blood groups differed between the two genders. Male patients of blood type A were 40 (42.55%), and female patients of blood group A were 35 (45.45%). Female patients of blood type O were 18 (23.37%), and male patients of blood group O were 21 (22.34%), as shown in table 2.

Moreover, Rh+ was also linked to an increased risk of COVID-19 infection. However, Rh was discovered to be correlated with a lower risk of COVID-19 infection (Table 3).

To assess the association between biomarkers and consequences in COVID-19 patients, hematological markers, including WBCs, neutrophils, lymphocytes, RBCs, hemoglobin (Hb), and platelets (PLT), as well as biochemical tests, including AST, ALT, GGT, and TB, were used. All laboratory tests included in this study are shown in tables 4, 5, and 6.

Table 1. A B O and Rh blood type allocation in COVID-19 illness

Blood type COVID-19 patients	Number	%
A	75	43.85
B	50	29.23
O	38	22.22
AB	8	4.67
RH+	150	87.71
RH-	21	12.28

Table 2. Allocation of A B O & Rh Blood Types among Males & Females

Blood Group	Male		Female	
	Number (94)	%	Number (77)	%
A	40	42.55	35	45.45
B	29	30.85	20	25.97
O	21	22.34	18	23.37
AB	4	4.25	4	5.19
Rh+	82	87.23	68	88.31
Rh-	12	12.76	9	11.68

Table 3. Association of Rh with susceptibility to COVID-19

Blood Group	Male		Female	
	Number (94)	%	Number (77)	%
A+	30	37.23	30	40.54
B+	23	24.46	19	24.67
O+	20	21.27	15	19.48
AB+	4	4.25	4	5.19
A-	5	5.31	2	2.59
B-	3	3.19	4	5.19
O-	4	4.25	3	3.89
AB-	-		-	

Table 4. ALT, AST, GGT and Tbili in patients

Group	Mean ± SE			
	ALT (U/L)	AST (U/L)	GGT (U/L)	Tbili.(mg/dl)
Sick peoples	30.64 ±1.36	37.46 ±1.42	35.16 ±1.32	12.78 ±0.51
Control	16.83 ±0.69	20.97 ±0.54	21.50 ±0.56	10.87 ±0.34
T-test	3.681 **	3.770 **	3.527 **	1.421 **
P-value	0.0001	0.0001	0.0001	0.0090

** ($P \leq 0.01$)

Table 5. Hb, PLT and RBCs in patients

Group	Mean ± SE		
	Hb(g/dl)	PLT($\times 10^3$/µl)	RBCs($\times 10^6$/µl)
Patients	10.42 ±0.16	185.77 ±2.84	3.62 ±0.09
Control	12.63 ±0.21	217.16 ±4.85	4.86 ±0.16
T-test	0.528 **	10.63 **	0.354 **
P-value	0.0001	0.0001	0.0001

** ($P \leq 0.01$)

Table 6. WBCs, Neutrophil and Lymphocyte in patients

Group	Mean ± SE		
	WBC(x10^3/µl)	Neutrophil(x10^3/µl)	Lymphocyte(x10^3/µl)
Patients	7.20 ±0.32	4.55 ±0.26	1.33 ±0.09
Control	4.93 ±0.15	2.67 ±0.17	2.00 ±0.18
T-test	0.793 **	0.688 **	0.422 **
P-value	0.0001	0.0001	0.0025

** ($P \leq 0.01$)

The WBC count was checked in all blood samples of COVID-19 patients enrolled in the current study. The mean WBCs of COVID-19 patients was significantly higher than that in the control (7.20±0.32 vs. 4.93±0.15, $P<0.0001$), as well as the mean neutrophils (4.55±0.26 vs. 2.67±0.26, $P<0.0001$), as shown in table 6. On the other hand, the mean lymphocyte, RBCs, PLT, and Hb were significantly lower in COVID-19 patients, compared to the control (1.33±0.09 vs. 2.00±0.18, $P<0.0025$; 3.62±0.09 vs 4.86±0.16, $P<0.0001$; 185.77±2.84 vs. 217.16±4.85, $P<0.0001$; and 10.42±0.16 vs. 12.63±0.21, $P<0.0001$, respectively), as illustrated in table 5.

The test of liver function revealed significantly higher levels of ALT, AST, GGT, and TB in COVID-19 patients, compared to the control: ALT (30.64±1.36 vs. 16.83±0.69, $P<0.0001$), AST (37.46±1.42 vs. 20.97±0.54, $P<0.0001$), GGT (35.16±1.32 vs. 21.50±0.56, $P<0.0001$), TB (12.78±0.51 vs. 10.87±0.34, $P<0.0090$), shown in table 4.

4. Discussion

The above analysis was conducted at Al-Yarmuk Teaching Hospital, Baghdad, Iraq, to evaluate the relationship between blood types and COVID-19 sensitivity, discovering that blood groups A and Rh+ are more common in COVID-19 patients.

Zhao, Meng (13) investigated a possible link between blood types and vulnerability to SARS-CoV-2. Since then, various researchers have also noted the

importance of blood types. The comparison of COVID-19 patients to healthy individuals has demonstrated that anti-A immunoglobulins with blood type O prevented the threat of such nutrients into fibers (8), while it has been proposed that due to similar processes, individuals with blood type O will be less infected with SARS-CoV-2 (13, 14). Despite the presence of anti-A immunoglobulin in blood type B, no studies have been conducted to demonstrate that blood group Bs are less vulnerable to SARS-CoV-2. The above disease has been explained by Gerard, Maggipinto (3) with anti-A immunoglobulin in blood type O becoming the IgG kind and anti-A antibodies in blood type B being the IgM form. Gerard, Maggipinto (3) investigated whether humans of B and/or O blood types are less likely to develop COVID-19, asserting the potential importance of anti-A immunoglobulin in COVID-19 vulnerability. It was previously discovered that anti-A immunoglobulins could indeed restrict the adherence of SARS-CoV-2 protein to insulin-like growth factor enzyme 2 (ACE2)-conveying cell cultures. According to Hoiland, Fergusson (15), critically ill COVID-19 caregivers of blood types A and AB who lacked anti-A immunoglobulins were much more inclined to necessitate ventilators and stay in life support longer than sick people with B/O blood types with anti-A antibodies. It is still not completely obvious which blood groups would be most susceptible to the disease and which are far less susceptible (16-26).

Moreover, a very small rise in vulnerability to the COVID-19 illness was discovered in persons with blood type AB who did not have any blood type immunoglobulin; therefore, the vulnerability of blood type O to the illness should require both of these processes. Illnesses with major bleeding are much more common in blood type A (27). Because all South American Indians get the O blood group, there is no evidence that the regularity of COVID-19 or the percentage of distribution is lower where South American Indians live.

Similarly, the current study investigated the reduction in lymphocyte and PLT counts between COVID-19 patients and the controls, which was investigated in other studies as well (28-30). According to various studies, another important condition among COVID-19 patients is lymphocytopenia (31, 32).

Zhao, Meng (13) discovered that lymphocytopenia increases the likelihood of severe COVID-19 by around three orders of magnitude. Because lymphocytes express ACE2 and CD147 with their membranes, it is speculated that SARS-CoV-2 may directly infiltrate them and result in lymphocyte lysis and lymphopenia (33, 34). One more concept is that high levels of cytokines, such as tumor necrosis factor and IL-6, in COVID-19 patients lead to lymphocyte-mediated toxicity (35), and thus lymphopenia hinders the body's defense mechanisms, giving rise to COVID-19 urgent cares and poor outcomes. A lower lymphocyte count was believed to be linked with a pathophysiologic method in deceased COVID-19 patients (36).

The findings show that COVID-19 patients had substantially lower protein concentrations than healthy subjects. Likewise, Liao, Liang (35) found thrombocytopenia in several severely infected COVID-19 patients and gentle thrombocytopenia in 20% of them. The incidence rate of thrombocytopenia ranged from less than 5% to around 53.6% (37, 38).

According to Lippi, Plebani (39), SARS-CoV-2 could cause thrombocytopenia by directly infecting marrow hematopoietic stem cells via ACE2 cell surfaces, allowing the virus to attack the cells.

Hb levels and RBC counts were considerably lower in COVID-19 patients than in the control subjects (40), illustrating that severe and critically ill patients had noticeably lower Hb and RBCs. Mei, Weinberg (41) discovered that RBC factors and Hb levels are considerably lower in COVID-19 patients, leading to anemia by inhibiting RBC production in stem cells. A further way SARS-CoV-2 collaborates with Hb particles inside RBCs results in denatured proteins and

less governance of Hb, which might affect increased respiration adhesion and discharge.

The RBC structure was demonstrated to be affected by the severe SARS-CoV-2 virus and COVID-19 disease (42, 43).

To evaluate the hematological adjustments, WBC contours have been created. WBCs and neutrophils were clinically meaningful. Li, Wang (2) discovered a notable increase in neutrophil and total WBC counts. Another study discovered higher WBC, neutrophil, and eosinophil counts (44). In the current study, the mean WBC and neutrophil counts were extremely high.

The interleukin storm, which is an indicator of severe SARS-CoV-2b infection, might explain neutrophilia in COVID-19 patients (45).

Current modifications show that liver involvement might be a popular COVID-19 measure, with up to 76.3% of people getting abnormal liver lab tests.

The existing study measured the increase in liver enzymes, such as ALT, AST, GGT, and TB (P<0.0001). Our research, like prior reports, illustrated the key role of hepatic and renal factors such as AST, ALT, and GGT (46-49). GGT is a cholangiocyte harm test (49).

The infective detector of SARS-CoV-2 liver engagement could be multipurpose, including viral illnesses of the liver, illnesses affected by cytokine storms, and hypoxemia due to pneumonia (50).

Chai, Hu discovered that cholangiocytes respond fairly fast to ACE2, indicating that somehow the liver may be a major bet for SARS-CoV-2. Elevated AST levels may indicate hepatocyte cell zone 3 injury issues. Zone 3 is the main pool of AST and is vulnerable to hypoxia. The AST discharge increases due to virus-induced excitotoxicity. Because AST is discovered in cytosols and peroxisomes, the association between SARS-CoV-2 and mitochondrial enzymes may raise AST levels. Elevated AST, ALT, and TB levels have been linked to clinical outcomes (51). The threshold of TB is an established marker for detecting liver failure. A recent study discovered that TB concentrations were markedly higher in COVID-19 patients, which is also consistent with previous findings (52-54)

Free bilirubin is produced as a byproduct of heme decomposition. Once established, free bilirubin binds to albumin and is quickly captured by hepatocytes. After being separated from albumin, unconjugated bilirubin transforms into conjugated bilirubin in hepatocytes and is expelled into the bile duct (55).

This study discovered that blood types A and B, as well as Rh+, are more susceptible to COVID-19 infection, whereas blood types O, AB, and Rh are at a lower risk.

Research lab diagnoses, such as lymphopenia, thrombocytopenia, neutrophilia, and elevated AST, ALT, and GGT, are substantially associated with poor outcomes in COVID-19 patients. These findings could be utilized as collaborative indicators in the initial management of high-risk COVID-19 patients, potentially improving forecasting and stillbirths.

Authors' Contribution

Study concept and design: H. H. K. and M. A. F.
Acquisition of data: H. H. K.
Analysis and interpretation of data: M. A. F.
Drafting of the manuscript: M. A. F.
Critical revision of the manuscript for important intellectual content: H. H. K.
Statistical analysis: H. H. K.
Administrative, technical, and material support: H. H. K.

Ethics

The human study was approved by the ethics committee of the Dijlah University College, Baghdad, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

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