RELATION BETWEEN ABO BLOOD GROUP TYPING AND COVID-19 INFECTION: ROLE OF ABO IN DISEASE SUSECEPTIBILITY AND OUTCOME.

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ABSTRACT:

Background: *The rapid spread of the global pandemic of SARS-CoV-2 has strained the healthcare systems and laboratory testing resources, thus making rapid prediction of disease severity and critical care requirements a critical challenge. Recent studies have demonstrated that blood type may affect the risk and severity of SARS COV-2 disease. Therefore, the aim of this study was to explore the effect of ABO blood groups on COVID-19 susceptibility and disease outcome in Egyptian COVID-19 patients.*

Aim of the work: *This study aims to explore the distribution of ABO and RH blood groups & to analyse their association with various laboratory parameters in newly diagnosed Egyptian Covid-19 patients.*

Patients and Methods: *400 samples from COVID-19 Egyptian patients were analyzed for blood group typing and compared to samples of 400 healthy blood donors. The association between ABO blood groups and laboratory investigations in addition to clinical characteristics and disease outcome was also identified.*

Results: *In the studied patients, blood group A was associated with highest rate of infection (33.5%), followed by blood group O (32 %), then blood group B (25 %) and least was blood group AB (9.5%). Laboratory investigations and severity analysis revealed that blood group O and B COVID-19 patients had poor prognosis whereas A and AB patients had favorable disease outcome.*

Conclusion: *The prevalence of COVID-19 was the highest in blood group A patients but the most severe cases were of blood group O. Thus, blood group typing could be used as a tool for rapid risk stratification and prediction of disease severity in COVID-19.*

Keywords: *COVID-19, ABO blood groups, Susceptibility, Severity*

INTRODUCTION:

In December 2019, a novel coronavirus, termed Corona virus disease (COVID-19), caused a group of acute atypical respiratory diseases in Wuhan, China now named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), The virus is transmittable between humans and has caused a pandemic worldwide. The number of death tolls continues to rise [1].

Health care systems, diagnosis, and treatment processes have been struggling with difficulties concerning the pandemic caused by coronavirus Covid-19 all over the world. Thus, there is a need to identify who is at more risk and, according to this,

provide protective measures as soon as possible[2].

The major blood group antigen are A and B resulting in the expression of ABO blood groups on RBCs and human tissues such as gastrointestinal, respiratory, nervous and vascular systems[3].

Many studies have found that the ABO blood groups play an important role in various human diseases, such as cardiovascular, oncological and some infectious and non-infectious diseases[4]. Therefore, this study aimed to explore the distribution of ABO blood groups & their association with various laboratory parameters in diagnosed Egyptian Covid-19 patients.

SUBJECTS AND METHODS:

Study design and methods:

This case-control study was conducted on 400 COVID-19 confirmed patients either home isolated patients or those recruited from Ain Shams University hospital wards and intensive care units. To represent the ABO blood distribution among the general population, the blood types of 400 healthy individuals who donated blood at the central blood bank of Ain Shams University Hospitals were also obtained.

Informed consents were obtained from all enrolled patients and/or their legal guardians and controls. The study was approved by the Scientific and Ethical Committee, Ain-Shams University (MS 317/2021) and was in accordance with declaration of Helsinki.

A confirmed COVID-19 case was defined as any patient who were tested positive for SARS COV-2 via a nasopharyngeal swab. Presence of SARS COV-2 was tested by polymerase chain reaction using ORF1ab and N genes as a target genes. Cases were also identified based on their symptomatic presentation by COVID-19 symptoms and/or laboratory investigations and subsequently were either home or hospital isolated and categorized into mild, moderate, severe and critical cases according to[5].

Serological tests:

ABO blood group typing was done by either gel card agglutination or automated methods. ABO forward/Reverse Grouping and Rh phenotype were done using ID-Cards provided by Diamed system, Switzerland. Blood group typing was also done on the NEO Iris_EU-001-100 analyzer (NEO Blood Bank Analyzer; Immucor, Norcross, GA).

Diagnostic parameters and severity predictors:

Routine laboratory diagnostic and prognostic workup of COVID-19 patients were performed in addition to clinical examination and assessment of disease outcome.

Routine hematological (CBC, coagulation profile and D Dimer), chemical (liver enzymes and LDH) and immunological (CRP and ferritin) markers were performed. The outcome recorded for patients was according to requirement of assisted ventilation and survival/death rates.

Statistical Analysis:

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric and median, inter-quartile range (IQR) when data found non-parametric.

Also, qualitative variables were presented as number and percentages.

The comparison between groups with qualitative data was done by using ***Chi-square test***. The comparison between two groups with quantitative data and parametric distribution were done by using ***Independent t-test.*** While the comparison between two

groups with quantitative data and non parametric distribution was done by using ***Mann-Whitney test.*** The comparison between more than two groups with quantitative data and parametric distribution were done by using ***One Way ANOVA test***. While the comparison between more than two groups with quantitative data and non parametric distribution was done by using ***Kruskall Wallis test.***

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

P > 0.05: Non significant
P < 0.05: Significant
P < 0.01: Highly significant.

RESULTS:

This study included 400 PCR confirmed COVID-19 patients. They were 174 males & 226 females, their age ranged between 18 & 93 years with mean ages (52.85 ± 15.90). They were subdivided into the following subgroups: Mild (48, 12.0 %), Moderate (250, 62.5%), Marked (50, 12.5%) and Severe (52, 13%).

Association between ABO and COVID-19 infection and severity:

Blood group distribution in studied COVID-19 patients and controls are shown in Table (1) and the diagram. The most frequently detected blood group amongst the COVID-19 patients and controls was blood group A (33.5% and 35% respectively). This was followed by blood group O (32% in both groups). Then blood group B (25% and 23.5% respectively) and the least group was AB (9.5% in both groups). A significant association was found between ABO, Hb levels and APTT (Table 2).

ABO significantly affected the clinical presentation and disease outcome in COVID-19 patients. Most of the studied patients were categorized as moderate group. Blood group O and B were at risk of severe and critical manifestations whereas the A and AB were mainly presented as mild cases (Table 3).

Table (1): Comparison between patients and controls according to ABO blood groups and Rh typing.

		Control group		Patients group		Test value*	P-value	Sig.
		No.	%	No.	%			
ABO	A	140	35.0%	134	33.5%	0.317	0.957	NS
	B	94	23.5%	100	25.0%			
	AB	38	9.5%	38	9.5%			
	O	128	32.0%	128	32.0%			
A	Non-A	260	65.0%	266	66.5%	0.200	0.655	NS
	A	140	35.0%	134	33.5%			
B	Non-B	306	76.5%	300	75.0%	0.245	0.621	NS
	B	94	23.5%	100	25.0%			
AB	Non-AB	362	90.5%	362	90.5%	0.000	1.000	NS
	AB	38	9.5%	38	9.5%			
O	Non-O	272	68.0%	272	68.0%	0.000	1.000	NS
	O	128	32.0%	128	32.0%			
Rh	Negative	29	7.3%	40	10.0%	1.919	0.166	NS
	Positive	371	92.8%	360	90.0%			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS) Chi-square test.

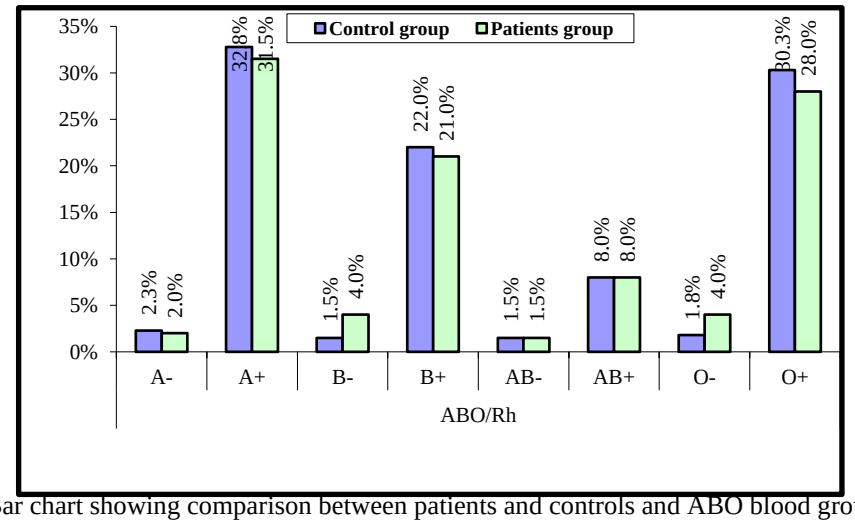

Diagram: Bar chart showing comparison between patients and controls and ABO blood groups and Rh typing.

Table (2): Comparison between Blood groups according to Haematological, immunological & hemical markers:

		ABO				Test value	P-value	Sig.
		A	B	AB	O			
		No. = 134	No. = 100	No. = 38	No. = 128			
TLC	Median (IQR)	7 (4.5 – 11.98)	8.6 (4.5 – 16.2)	8.8 (5.8 – 10.8)	9.15 (4.22 – 15.11)	1.500‡	0.682	NS
	Range	1.9 – 38.33	2.5 – 33.2	3 – 26.1	0.1 – 38.33			
Plt	Median (IQR)	229 (174 – 271)	209 (180 – 301)	200 (142 – 245)	229 (152 – 260.5)	3.636‡	0.304	NS
	Range	5 – 824	5 – 824	47 – 394	1 – 824			
HB	Mean ± SD	11.52 ± 2.10	10.93 ± 2.19	11.73 ± 2.51	10.79 ± 2.78	3.021	0.030	S
	Range	6.9 – 16.1	5.2 – 14.4	5.2 – 15.3	4.9 – 16.9			
Lym%	Median (IQR)	14 (6 – 26)	12 (6.2 – 29.7)	14 (5.8 – 34.2)	11.55 (6 – 23.2)	1.808‡	0.613	NS
	Range	1.5 – 56.5	2 – 53	2 – 55.7	0 – 61.4			
Lym	Median (IQR)	0.9 (0.45 – 1.5)	1.1 (0.6 – 1.6)	1.5 (0.5 – 3.08)	0.83 (0.5 – 1.55)	7.534‡	0.057	NS
	Range	0.2 – 63.3	0.15 – 63.3	0.2 – 63.3	0 – 3.2			
Neut %	Mean ± SD	74.46 ± 18.18	73.99 ± 19.29	70.69 ± 20.51	74.71 ± 21.46	0.433	0.730	NS
	Range	29.7 – 97.4	29.7 – 97	29.7 – 96	0 – 97.4			
Neut	Median (IQR)	4.7 (2.9 – 10.7)	6.39 (3.3 – 12.9)	6.9 (3.3 – 9.5)	6.38(2.98 – 13.15)	0.944‡	0.815	NS
	Range	0.9 – 34.88	1 – 30	1 – 23	0 – 34.88			
PT	Median (IQR)	13.4 (12 – 16.4)	13.3 (12 – 16.4)	13.8 (12.6 – 16.4)	13.85(12.29 – 17.6)	6.309‡	0.097	NS
	Range	10.8 – 36	10.8 – 60	12 – 60	10.8 – 60			
INR	Median (IQR)	1.1 (1 – 1.32)	1.13 (1 – 1.41)	1.18 (1.04 – 1.28)	1.12 (1 – 1.49)	4.077‡	0.253	NS
	Range	1 – 2.97	1 – 2.97	1 – 1.55	1 – 11.1			
APTT	Mean ± SD	40.07 ± 13.67	43.75 ± 20.90	50.89 ± 27.19	47.45 ± 22.72	4.384	0.005	HS
	Range	23 – 85	20 – 120	27 – 120	23 – 120			
D-Dimer	Median (IQR)	0.99 (0.54 – 2.89)	1.78 (0.7 – 3.8)	1.68 (0.95 – 3.2)	1.34 (0.59 – 2.66)	6.534‡	0.088	NS
	Range	0.1 – 10.1	0.11 – 7.1	0.1 – 11.6	0.2 – 1820			
AST	Median (IQR)	28 (17 – 42)	30.5 (18 – 42)	23 (16 – 48)	27.5 (15 – 41.5)	1.208‡	0.751	NS
	Range	6 – 206	8 – 179	11 – 306	7 – 455			
ALT	Median (IQR)	23 (17 – 37)	24 (14 – 38)	21 (17 – 41)	25.5 (16.5 – 36)	0.121‡	0.989	NS
	Range	6 – 132	6 – 82	10 – 288	6 – 480			
LDH	Median (IQR)	288 (190 – 451)	297.5 (177 – 454)	336 (155 – 544)	328 (227.5 – 633)	4.450‡	0.217	NS
	Range	113 – 1378	92 – 1943	88 – 3137	77 – 2237			
CRP	Median (IQR)	39.74 (18 – 92.62)	50.0(18.24–112.56)	35.4 (13 – 80)	47.25 (15 – 97.5)	1.172‡	0.760	NS
	Range	2 – 235.2	4.8 – 315.6	5 – 450	0.6 – 529.2			
Ferrtin	Median (IQR)	449 (294 – 1165)	686.95(344 – 1177)	583 (230 – 1200)	613(200.45 – 1200)	4.413‡	0.220	NS
	Range	38 – 2621	41.8 – 3083	41.5 – 1368	34 – 4662			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS) •: One Way ANOVA test; ‡: Kruskal Wallis test

Table (3): Comparison between blood groups according to Severity, comorbidity, survival & ventilation.

		ABO								Test value*	P-value	Sig.
		A		B		AB		O				
		No.	%	No.	%	No.	%	No.	%			
Vent	No vent	114	85.1%	88	88.0%	36	94.7%	108	84.4%	3.129	0.372	NS
	Vent	20	14.9%	12	12.0%	2	5.3%	20	15.6%			
Co-morbidity	No	128	95.5%	84	84.0%	38	100.0%	118	92.2%	22.132	0.104	NS
	Renal disease	2	1.5%	2	2.0%	0	0.0%	2	1.6%			
	Cardiac	4	3.0%	8	8.0%	0	0.0%	6	4.7%			
	Surgery	0	0.0%	2	2.0%	0	0.0%	2	1.6%			
	Blood disease	0	0.0%	2	2.0%	0	0.0%	0	0.0%			
	Diabetic	0	0.0%	2	2.0%	0	0.0%	0	0.0%			
Survival	Alive	121	90.3%	95	95.0%	37	97.4%	117	91.4%	3.356	0.340	NS
	Died	13	9.7%	5	5.0%	1	2.6%	11	8.6%			
Severity	Mild	24	17.9%	6	6.0%	6	15.8%	12	9.4%	18.352	0.031	S
	Moderate	78	58.2%	68	68.0%	28	73.7%	76	59.4%			
	Severe	12	9.0%	16	16.0%	2	5.3%	20	15.6%			
	Critical	20	14.9%	10	10.0%	2	5.3%	20	15.6%			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

*:Chi-square test

Clinical and laboratory characteristics of the included patients

Analysis of the ABO blood groups regarding their laboratory investigations and disease outcome showed that blood groups O and B were significantly associated with poor prognostic markers such as high D-Dimer and prolonged APTT. Blood group O patients were also presented with anemia and high LDH levels. Blood group B patients were commonly associated with cardiac co-morbidities (Tables 4 and 5).

On the other hand, COVID-19 patients of A blood group were significantly associated with high hemoglobin counts, shortened APTT and low ferritin levels. AB patients were presented high lymphocytic counts and prolonged APTT time (Table 6 and 7).

Table (4): Comparison between patients with O blood group & non O blood group according to hematological, chemical and immunological lab parameters.

		O		Test value	P-value	Sig.
		Non-O	O			
		No. = 272	No. = 128			
TLC	Median (IQR)	7.75 (4.5 – 11.83)	9.15 (4.22 – 15.11)	-0.874‡	0.382	NS
	Range	1.9 – 38.33	0.1 – 38.33			
Plt	Median (IQR)	211 (174 – 275.5)	229 (152 – 260.5)	-0.245‡	0.807	NS
	Range	5 – 824	1 – 824			
HB	Mean ± SD	11.33 ± 2.21	10.79 ± 2.78	2.104•	0.036	S
	Range	5.2 – 16.1	4.9 – 16.9			
Lym%	Median (IQR)	14 (6 – 29.7)	11.55 (6 – 23.2)	-1.139‡	0.255	NS
	Range	1.5 – 56.5	0 – 61.4			
Lym	Median (IQR)	1.01 (0.5 – 1.65)	0.83 (0.5 – 1.55)	-1.673‡	0.094	NS
	Range	0.15 – 63.3	0 – 3.2			
Neut %	Mean ± SD	73.76 ± 18.90	74.71 ± 21.46	-0.450•	0.653	NS
	Range	29.7 – 97.4	0 – 97.4			
Neut	Median (IQR)	5.75 (3.25 – 10.86)	6.38 (2.98 – 13.15)	-0.540‡	0.589	NS
	Range	0.9 – 34.88	0 – 34.88			
PT	Median (IQR)	13.4 (12 – 16.4)	13.85 (12.29 – 17.6)	-1.856‡	0.064	NS
	Range	10.8 – 60	10.8 – 60			
INR	Median (IQR)	1.13 (1 – 1.38)	1.12 (1 – 1.49)	-1.611‡	0.107	NS
	Range	1 – 2.97	1 – 11.1			
APTT	Mean ± SD	42.93 ± 19.12	47.45 ± 22.72	-2.070•	0.039	S
	Range	20 – 120	23 – 120			
D-Dimer	Median (IQR)	1.34 (0.6 – 3.2)	1.34 (0.59 – 2.66)	-0.549‡	0.583	NS
	Range	0.1 – 11.6	0.2 – 1820			
AST	Median (IQR)	28 (17 – 42)	27.5 (15 – 41.5)	-0.308‡	0.758	NS
	Range	6 – 306	7 – 455			
ALT	Median (IQR)	23 (17 – 38)	25.5 (16.5 – 36)	-0.173‡	0.863	NS
	Range	6 – 288	6 – 480			
LDH	Median (IQR)	299 (188 – 454.5)	328 (227.5 – 633)	-2.008‡	0.045	S
	Range	88 – 3137	77 – 2237			
CRP	Median (IQR)	39.74 (18.12 – 93.83)	47.25 (15 – 97.5)	-0.484‡	0.628	NS
	Range	2 – 450	0.6 – 529.2			
Ferrtin	Median (IQR)	568.25 (322.85 – 1188.5)	613 (200.45 – 1200)	-0.749‡	0.454	NS
	Range	38 – 3083	34 – 4662			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Independent t-test; ‡: Mann Whitney test

Table (5): Comparison between patients with B blood group & non B blood group according to hematological, chemical and immunological lab parameters:

		B		Test value	P-value	Sig.
		Non-B	B			
		No. = 300	No. = 100			
TLC	Median (IQR)	8.1 (4.5 – 12.46)	8.6 (4.5 – 16.2)	-0.234‡	0.815	NS
	Range	0.1 – 38.33	2.5 – 33.2			
Plt	Median (IQR)	222 (170 – 262)	209 (180 – 301)	-0.697‡	0.486	NS
	Range	1 – 824	5 – 824			
HB	Mean ± SD	11.23 ± 2.48	10.93 ± 2.19	1.078•	0.282	NS
	Range	4.9 – 16.9	5.2 – 14.4			
Lym%	Median (IQR)	13 (6 – 26)	12 (6.2 – 29.7)	-0.164‡	0.870	NS
	Range	0 – 61.4	2 – 53			
Lym	Median (IQR)	0.92 (0.5 – 1.6)	1.1 (0.6 – 1.6)	-1.381‡	0.167	NS
	Range	0 – 63.3	0.15 – 63.3			
Neut %	Mean ± SD	74.09 ± 19.91	73.99 ± 19.29	0.044•	0.965	NS
	Range	0 – 97.4	29.7 – 97			
Neut	Median (IQR)	5.75 (3.2 – 11.09)	6.39 (3.3 – 12.9)	-0.382‡	0.703	NS
	Range	0 – 34.88	1 – 30			
PT	Median (IQR)	13.6 (12 – 17.3)	13.3 (12 – 16.4)	-0.944‡	0.345	NS
	Range	10.8 – 60	10.8 – 60			
INR	Median (IQR)	1.13 (1 – 1.46)	1.13 (1 – 1.41)	-0.306‡	0.759	NS
	Range	1 – 11.1	1 – 2.97			
APTT	Mean ± SD	44.59 ± 20.29	43.75 ± 20.90	0.356•	0.722	NS
	Range	23 – 120	20 – 120			
D-Dimer	Median (IQR)	1.3 (0.57 – 2.66)	1.78 (0.7 – 3.8)	-2.020‡	0.043	S
	Range	0.1 – 1820	0.11 – 7.1			
AST	Median (IQR)	27 (17 – 42)	30.5 (18 – 42)	-1.015‡	0.310	NS
	Range	6 – 455	8 – 179			
ALT	Median (IQR)	23 (17 – 37)	24 (14 – 38)	-0.030‡	0.976	NS
	Range	6 – 480	6 – 82			
LDH	Median (IQR)	312 (208 – 533)	297.5 (177 – 454)	-0.999‡	0.318	NS
	Range	77 – 3137	92 – 1943			
CRP	Median (IQR)	40.17 (17 – 93.66)	50.04 (18.24 – 112.56)	-0.645‡	0.519	NS
	Range	0.6 – 529.2	4.8 – 315.6			
Ferrtin	Median (IQR)	556 (230 – 1200)	686.95 (344 – 1177)	-1.393‡	0.163	NS
	Range	34 – 4662	41.8 – 3083			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Independent t-test; ‡: Mann Whitney test

Table (6): Comparison between patients with A blood group & non A blood group according to CBC parameters, PT, APTT, D-Dimer, CRP, ferritin, LDH, AST & ALT.

		A		Test value	P-value	Sig.
		Non-A	A			
		No. = 255	No. = 134			
TLC	Median (IQR)	8.8 (4.5 – 13.6)	7 (4.5 – 11.98)	-1.175‡	0.240	NS
	Range	0.1 – 38.33	1.9 – 38.33			
Plt	Median (IQR)	211 (162 – 271)	229 (174 – 271)	-0.713‡	0.476	NS
	Range	1 – 824	5 – 824			
HB	Mean ± SD	10.98 ± 2.55	11.52 ± 2.10	-2.125•	0.034	S
	Range	4.9 – 16.9	6.9 – 16.1			
Lym%	Median (IQR)	12 (6 – 26)	14 (6 – 26)	-0.851‡	0.395	NS
	Range	0 – 61.4	1.5 – 56.5			
Lym	Median (IQR)	1 (0.5 – 1.6)	0.9 (0.45 – 1.5)	-0.869‡	0.385	NS
	Range	0 – 63.3	0.2 – 63.3			
Neut %	Mean ± SD	73.86 ± 20.50	74.46 ± 18.18	-0.283	0.777	NS
	Range	0 – 97.4	29.7 – 97.4			
Neut	Median (IQR)	6.38 (3.25 – 12.1)	4.7 (2.9 – 10.7)	-0.966‡	0.334	NS
	Range	0 – 34.88	0.9 – 34.88			
PT	Median (IQR)	13.6 (12 – 17.33)	13.4 (12 – 16.4)	-1.721‡	0.085	NS
	Range	10.8 – 60	10.8 – 36			
INR	Median (IQR)	1.13 (1 – 1.46)	1.1 (1 – 1.32)	-1.675‡	0.094	NS
	Range	1 – 11.1	1 – 2.97			
APTT	Mean ± SD	46.55 ± 22.80	40.07 ± 13.67	3.026•	0.003	HS
	Range	20 – 120	23 – 85			
D-Dimer	Median (IQR)	1.4 (0.67 – 3.2)	0.99 (0.54 – 2.89)	-1.910‡	0.056	NS
	Range	0.1 – 1820	0.1 – 10.1			
AST	Median (IQR)	28 (17 – 42)	28 (17 – 42)	-0.724‡	0.469	NS
	Range	7 – 455	6 – 206			
ALT	Median (IQR)	23 (17 – 38)	23 (17 – 37)	-0.284‡	0.776	NS
	Range	6 – 480	6 – 132			
LDH	Median (IQR)	322 (210 – 544)	288 (190 – 451)	-1.182‡	0.237	NS
	Range	77 – 3137	113 – 1378			
CRP	Median (IQR)	46.08 (15 – 98)	39.74 (18 – 92.62)	-0.645‡	0.519	NS
	Range	0.6 – 529.2	2 – 235.2			
Ferrtin	Median (IQR)	623 (233 – 1200)	449 (294 – 1165)	-1.965‡	0.049	S
	Range	34 – 4662	38 – 2621			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Independent t-test; ‡: Mann Whitney test

Table (7): Comparison between patients with AB blood group & non AB blood group according to hematological, chemical and immunological lab parameters.

		AB		Test value	P-value	Sig.
		Non-AB	AB			
		No. = 362	No. = 38			
TLC	Median (IQR)	7.8 (4.5 – 13.6)	8.8 (5.8 – 10.8)	-0.156‡	0.876	NS
	Range	0.1 – 38.33	3 – 26.1			
Plt	Median (IQR)	222 (174 – 271)	200 (142 – 245)	-1.788‡	0.074	NS
	Range	1 – 824	47 – 394			
HB	Mean ± SD	11.10 ± 2.40	11.73 ± 2.51	-1.523•	0.128	NS
	Range	4.9 – 16.9	5.2 – 15.3			
Lym%	Median (IQR)	13 (6 – 26)	14 (5.8 – 34.2)	-0.685‡	0.494	NS
	Range	0 – 61.4	2 – 55.7			
Lym	Median (IQR)	0.9 (0.5 – 1.6)	1.5 (0.5 – 3.08)	-2.022‡	0.043	S
	Range	0 – 63.3	0.2 – 63.3			
Neu%	Mean ± SD	74.42 ± 19.64	70.69 ± 20.51	1.108•	0.268	NS
	Range	0 – 97.4	29.7 – 96			
Neut	Median (IQR)	5.7 (3.2 – 12.1)	6.9 (3.3 – 9.5)	-0.133‡	0.894	NS
	Range	0 – 34.88	1 – 23			
PT	Median (IQR)	13.6 (12 – 17.3)	13.8 (12.6 – 16.4)	-1.212‡	0.225	NS
	Range	10.8 – 60	12 – 60			
INR	Median (IQR)	1.12 (1 – 1.46)	1.18 (1.04 – 1.28)	-0.650‡	0.516	NS
	Range	1 – 11.1	1 – 1.55			
APTT	Mean ± SD	43.69 ± 19.49	50.89 ± 27.19	-2.077•	0.038	S
	Range	20 – 120	27 – 120			
D-Dimer	Median (IQR)	1.34 (0.6 – 3)	1.68 (0.95 – 3.2)	-0.966‡	0.334	NS
	Range	0.1 – 1820	0.1 – 11.6			
AST	Median (IQR)	28 (17 – 42)	23 (16 – 48)	-0.156‡	0.876	NS
	Range	6 – 455	11 – 306			
ALT	Median (IQR)	23 (17 – 36)	21 (17 – 41)	-0.227‡	0.820	NS
	Range	6 – 480	10 – 288			
LDH	Median (IQR)	303 (200 – 516)	336 (155 – 544)	-0.183‡	0.855	NS
	Range	77 – 2237	88 – 3137			
CRP	Median (IQR)	45 (17.7 – 96)	35.4 (13 – 80)	-0.684‡	0.494	NS
	Range	0.6 – 529.2	5 – 450			
Ferrtin	Median (IQR)	572.8 (285 – 1200)	583 (230 – 1200)	-0.086‡	0.932	NS
	Range	34 – 4662	41.5 – 1368			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS) •: Independent t-test; ‡: Mann Whitney test

DISCUSSION:

Coronavirus disease 2019 (COVID-19), is currently one of the worst pandemics reported ever. Severe Acute Respiratory syndrome Coronaviridae 2 (SARS-CoV2), the culprit of COVID-19, is a highly virulent virus, resulting in an acute form of respiratory distress that was declared by the World Health Organization (WHO) declared as a global pandemic[6].

Many researchers have related the variability of the host to the disease susceptibility to different pathogens according to the difference in ABO blood

groups. Blood group antigens may act as receptors to pathogens, affecting pathogenic pathways and modifying the immune response[7].

Recently, many studies have discovered relationships between ABO blood group system and SARS-COV-2 infection, severity and demise. However, the results of these studies are contradictory.The contradiction between the results could be attributed to different sample sizes or population heterogeneity[8].

group A was the predominant being found in 32.5%, followed by O+ (32%) then B+ (25%) and AB was the least common (9.5%). A similar distribution pattern was observed by **Li et al., 2020** as blood group typing of SARS COVID-19 patients was 39.3%, 35.7%. 25.3% and 9.8% for A, O, B and AB groups respectively [9].

Different blood group distribution in COVID-19 patients was detected by **Latz et al., 2020** as they found that the most common blood group was O (45.5%), then A group (34.2%), and the least detected groups were B and AB found in 15.6% and 4.7% respectively. Moreover**, Aljanobi et al. 2020** found that patient**s** with blood group O is equally affected as patients with blood group B in Saudi Arabian patients and they more than patients with blood group A and the least count of patients were of blood group AB. ABO distribution in COVID-19 patients is usually country specific [12].

Phenotyping of our patients was almost identical to the that of the enrolled healthy blood donors. The frequencies of A, O, B and AB were 32.8%, 30.3%, 22% and 8% respectively. This was in accordance with a previous study that was done by **AbdElMonem et al., 2019** and included 40591 Egyptian blood donors and found that blood group A was the most common (35.12% of the patients) then O (31.94%), B was found in 23.12% and the least prevalent was AB only in 9.74% of the donors [13].

Besides, **Latz et al., 2020** couldn't find significant difference between blood grouping of COVID-19 patients and controls[10].

Severity analysis of our patients has shown that anti-A harboring blood groups (O and B) were mostly presented as severe and critical cases unlike groups lacking anti-A antibodies (A and AB groups) that were seldom characterized with complicated diseases.

Our findings were in accordance with those demonstrated by **Kabrah et al., in 2021** as the found the most complicated COVID-19 cases were of group O and the least where of AB. **Almahdi et al., 2020** also demonstrated that most of ICU admitted COVID-19 patients were blood group O and B [12,14].

These results were contradictory to **Hoiland et al., 2020** asThey found that A and AB patients represented high risk patients requiring mechanical ventilation, renal replacement therapy and more prolonged admission to intensive care units than blood group O and B patients[15].

Patients of O group were presented with anemia and high LDH levels. Low hemoglobin values are independently associated with severe COVID-19 disease and increased mortality in hospitalized patients with pneumonia [16]. LDH is also identified as a powerful early predictor for lung injury in severe COVID-19 cases [17].

O and B patients were also associated with markers of COVID-19 coagulopathy where O patients had prolonged APTT whereas B patients were significantly associated with high D-Dimer levels. Abnormalities of hemostatic factors such as D-Dimer and coagulation profile testing at the time of admission were discovered to be associated with disease severity and mortality [18].

Our data revealed that blood group A patients were predominantly young patients

representing moderate and mild COVID-19 cases**.** Moreover, laboratory investigations of the current patients showed that blood group A wasn't associated with poor prognostic markers such as low hemoglobin levels, prolonged APTT or high ferritin levels. Previous reports have shown that hospitalized COVID-19 patients with lymphopenia and high ferritin levels had a significantly adverse outcome and higher risk of death **[19].**

Regarding AB blood group, our findings revealed a significant association with high lymphocytic counts compared to non-AB patients indicating a favorable course of the disease. The one current exception suggested by our results was the prolongation of APTT in blood group B patients. This was supported by previous studies revealed that prolongation of APTT isn't a conclusive marker in COVID-19 as it can be affected by other factors rather than SARS COV-2 infection such as anticoagulants used in treatment of COVID-19 patients in addition to heterogeneity of patients that may affect APTT results **[20].**

The limited access to detailed baseline clinical and laboratory characteristics in addition to pre-existing conditions and medications is the main limitation to this study. It's therefore not possible to accurately determine the factors other than SARS COV-2 infection that may influence patient's condition and requirement for critical care admission.

In conclusion, our study demonstrated that blood group A is at increased risk of SARS COV-2 infection. Blood group O has lower susceptibility, but they are more vulnerable to poor disease outcome. However, the pre-existing condition, medication and time of beginning thereby are the main determinant factors for severity and morbidity in SARS COV-2 infection

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العلاقة بين فصائل الدم الدم ABO وعدوى بفيروس كورونا المستجد كوفيد-١٩ :دور ABO في قابلية المرض والنتيجة.

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نـبـذة مـختـصرة

أدى الانتشار السريع للوباء العالمي لـ SARS-CoV-2 إلى إجهاد أنظمة الرعاية الصحية وموارد الاختبارات المعملية ، مما يجعل التنبؤ السريع لشدة المرض ومتطلبات الرعاية الحرجة تحديًا خطيرًا. أظهرت الدراسات الحديثة أن فصيلة الدم قد تؤثر على مخاطر وشدة مرض السارس .COV-2لذلك ، كان **الهدف من هذه الدراسة** هو استكشاف تأثير فصائل الدم ABO على القابلية للإصابة بـ **كوفيد-١٩** ونتائج المرض لدى مرضى **كوفيد-١٩** المصريين.

المرضى والطرق: تم تحليل ٤٠٠ عينة من مرضى **كوفيد-١٩** المصريين من أجل تصنيف فصيلة الدم ومقارنتها بعينات٤٠٠ من متبرعين بالدم الأصحاء. كما تم تحديد العلاقة بين فصائل الدم ABO والفحوصات المخبرية بالإضافة إلى الخصائص السريرية ونتائج المرض.

النتائج: في المرضى الخاضعين للدراسة ، ارتبطت فصيلة الدم A بأعلى معدل إصابة (٣٣,٥٪) ، تليها فصيلة الدم O (32٪ (، ثم فصيلة الدم B (25٪ (وأقلها فئة الدم AB (9.5٪ . .(كشفت الفحوصات المخبرية وتحليل الشدة أن مرضى فصيلة الدم O و B COVID-19 كان لديهم تشخيص سيئ في حين أن مرضى A و AB كان لديهم نتائج مرضية مواتية.

لخلاصة: كان انتشار **كوفيد-١٩** هو الأعلى في مرضى فصيلة الدم A ولكن الحالات الأكثر خطورة كانت من فصيلة الدم .Oوبالتالي ، يمكن استخدام تصنيف فصيلة الدم كأداة لتصنيف المخاطر بسرعة والتنبؤ بشدة المرض في **كوفيد-١٩**.