Distribution of ABO blood groups and association to low risk of COVID-19 infection in patients

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Research

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Abstract

Background

Since December 2019, the novel coronavirus pandemic (COVID-19) has become a global health emergency. To date, studies on the correlation between ABO blood groups and COVID-19 infected risk had rarely reported. This study aimed to describe the ABO blood groups distribution and association to low risk of COVID-19 infection for effectively concerning about the susceptible population.

Methods

We included 138 COVID-19 diagnosed patients and 82 non- COVID-19 patients between January 21 and February 20, 2020. We compared ABO blood group distribution, gender distribution and correlation analysis in Severe, Non-severe and Non-COVID19 patients, and analyzed the laboratory indexes of type O and non-type O groups in COVID19 patients.

Results

The laboratory results were significantly difference between type O and non-type O COVID19 patients ($P < 0.05$). Patients with blood type O had lower risk of severe COVID-19 infection ($\chi^2 = 4.066$, $p = 0.044$, $OR = 0.380$), and especially, female with the type O blood had lower risk in deteriorating severe COVID19 infection ($p = 0.049$).

Conclusion

Patients with the blood group of type O had relatively lower risk of COVID19 infection, especially, female with the type O blood had lower risk in deteriorating severe COVID19 infection. We should concern more to the patients with non-type O blood to minimize the risk of COVID19 infection.

Background

With the wide spread of COVID-19 pandemic in all over world, we can't quickly know whether the people around us were infected with COVID-19, especially in the large recovery of working and studying. As not every country can afford testing nucleic acid to confirm the COVID-19 infected. In China, the first wave of COVID-19 outside of Hubei has abated because of aggressive non-pharmaceutical interventions. However, particularly from overseas importation, the second wave of COVID-19 propagation is possible[1]. Which was studied by Xu, et al and his colleagues [2], Vulnerable people need protection, The ABO blood group system, the most extensively investigated erythrocyte antigen system, which influences the host susceptibility and widely used in clinical practice, ABO blood groups have already been biologically associated with many chronic diseases such as Cancer[3–5], which indicated the ABO blood

type influenced the long-term outcomes of Japanese patients with Pancreatic, presumably due to its impact on disease onset and tumor behavior and the ABO blood group showed no significant effect on the clinicopathological parameters of gastric cancer, The O blood group may be a prognostic factor for gastric cancer patients. ABO blood group is also related to the prognosis of many diseases[6–9].

Prospective studies included ABO blood group associated with other disease, which may be clinically significant [10–12]. But, the association ABO blood group and COVID-19 infected risk has rarely reported. With this in mind, we set out to definitively describe the ABO blood groups distribution and evaluate the correlation between ABO blood group and COVID-19 infected risk. Basically up to this clinical significance value, we should concern more to the patients with blood types O to minimize the risk of COVID19 infection in patients for effectively assisting to protect susceptible population.

Method

Clinical patients' demographic data

This retrospective study was conducted in Public Hygiene Center in Taizhou Hospital, of Zhejiang province, from January 21 to February 20 in 2020. The study flowchart was described in Figure1. We included 138 cases of COVID-19 diagnosed patients and 82 cases of non- COVID-19 patients. We compared ABO blood group distribution and gender distribution among severe, non-Severe COVID-19 patients with non-COVID-19 patient, and we also compared type O and non-type O COVID-19 patients. At the same time, we analyzed the laboratory indexes of type O and non-type O groups in COVID19 patients. the results were followed up to March 11. The study was approved by the institutional review board and the Ethics Committee of the Zhejiang Taizhou Hospital affiliated to Wenzhou Medical University (K20200112) and the informed written consent from all participants were obtained.

Figure1. The flowchart of COVID-19 confirmed and non-COVID-19 cohort.

The majority of suspected patients were being diagnosed as confirmed COVID-19 positive patients with CT and ET-PCR then regrouped confirmed cases into severe and non-severe patients.

Study population

Positive and negative stereotypes are detected automatically by AutoVue automatic blood group analyzer (Johnson & Johnson, USA) . 220 ABO Blood group data were collected between January 21 and February 20 in 2020 in Taizhou Hospital, of Zhejiang province, which divided into three groups included Severe , Non-severe, Non-COVID19 patients groups .

Statistical methods

Statistical analyses were performed using SPSS version 25.0 software (IBM, US). Frequency rates and percentages were described as the categorical variables, and median and interquartile range (IQR) values were described as continuous variables. Medians for continuous variables if the data were nonnormally

distributed were compared using independent group Mann-Whitney U test; categorical variables were compared using the Chi-square test, P value < 0.05 was considered statistically significant. The figures were plotted using GraphPad Prism version 8.0.

Results

Characteristics of patients

From January 21 to February 20 in 2020, a total of 200 suspected infected patients included 138 COVID-19 diagnosed patients and 82 non-COVID-19 patients by real-time RT-PCR, CT radiograph and clinical symptoms. The median age was 50, of which 74 were male (53.6%), and 70 (50.7%) had a history of returned from Wuhan and 31 (22.5%) Contact with people returned from the epidemic area. The clinical manifestations of the patient were fever 97 (70.3%), and cough 79 (57.2%) people, Expectoration 44 (31.9%), pharyngalgia 14 (10.1%) people, fatigue 31 (22.5%), headache 15 (10.9%), a few cases of diarrhea 11 (8.0%), chest tightness 12 (8.7%). With the Comorbidities of diabetes 12 (8.7%), Hypertension 22 (15.9%), Chronic pulmonary disease 11 (8.0%), Digestive system disease 17 (12.3%), Kidney disease 2 (1.4%). And 14 (10.1%) have the habit of smoking. At the same time, 82 patients with negative nucleic acid of SARS-CoV-2 who

were returned from Wuhan or had the history of contacting with people returned from the epidemic area collected during the same period, Complete demographic information for the study population is provided in Table 1.

Table 1. Clinical Characteristics and Comorbidity of COVID19 and Non-COVID19 Patients

Characteristics	Total (N=220)	COVID19 (N=138)	Non-COVID19 (N=82)	Statistics	P value
Sex — no. (%)					
Male	113 (51.4)	74 (53.6)	39 (47.6)	0.757	0.384
Female	107 (48.6)	64 (46.4)	43 (52.4)		
Age median (IQR), y	50 (40-56)	50 (40-56)	42 (32-56)	-5.935	0.000*
Contact history— no. (%)					
Returned from Wuhan	124 (56.4)	70 (50.7)	54 (65.9)	4.844	0.028*
Contact with people returned from the epidemic area	59 (26.8)	31 (22.5)	28 (34.1)	3.517	0.061
Smoke — no. (%)	28 (12.7)	18 (13.0)	10 (12.2)	0.033	0.855
Symptoms — no. (%)					
Fever	151 (68.6)	97 (70.3)	54 (65.9)	0.468	0.494
Cough	133 (60.5)	79 (57.2)	54 (65.9)	1.607	0.205
Expectoration	80 (36.4)	44 (31.9)	36 (43.9)	3.184	0.074
Headache	23 (10.5)	15 (10.9)	8 (9.8)	0.069	0.793
Pharyngalgia	29 (13.2)	14 (10.1)	15 (18.3)	2.894	0.089
Fatigue	44 (20.0)	31 (22.5)	13 (15.9)	1.441	0.230
Diarrhea	15 (6.8)	11 (8.0)	4 (4.9)	0.811	0.368
Chest tightness	17 (7.7)	12 (8.7)	5 (6.1)	0.502	0.478
Comorbidity — no. (%)					
Diabetes	16 (7.3)	12 (8.7)	4 (4.9)	1.174	0.279
Hypertension	31 (14.1)	22 (15.9)	9 (11.0)	1.080	0.299
Chronic pulmonary disease	14 (6.4)	11 (8.0)	3 (3.7)	1.735	0.188
Digestive system disease	20 (9.1)	17 (12.3)	3 (3.7)	5.291	0.021*
Kidney disease	2 (0.9)	2 (1.4)	0 (0.0)	-	0.530

Note: p values were obtained by a Chi-square test or Mann-Whitney U test. P values indicate differences between COVID19 and Non-COVID19 patients, * P < 0.05 was considered statistically significant.

ABO blood group distribution

Table 2 described ABO blood group distribution in Severe, Non-severe and Non-COVID19 patients and the blood group type distribution in Severe , Non-severe and Non-COVID19 patients were A = B > O > AB, O > A > B > AB, O > B > A > AB, respectively (Fig 2).

Table 2. ABO blood group distribution in Severe, Non-severe and Non-COVID19 patients.

Patients				Gender	Type A	Type B	Type AB	Type O	Non-Type O
COVID19 (N=138)	Severe (N=32)		total		11(34.4%)	11(34.4%)	4 (12.5%)	6 (18.8%)	26(81.2%)
				male	7(36.8%)	4(21.1%)	2 (10.5%)	6 (31.6%)	
				female	4(30.7%)	7(53.8%)	2 (15.4%)	0 (0.0%)	
	Non-severe (N=106)		total		30(28.3%)	29 (27.4%)	12(11.3%)	35(33.0%)	71(67.0%)
				male	16(29.1%)	15(27.3%)	5(9.1%)	19(34.5%)	
				female	14(27.5%)	14(27.5%)	7 (13.7%)	16(31.4%)	
	Non-COVID19 (N=82)		total		22(26.8%)	23(28.0%)	6(7.3%)	31(37.8%)	51(62.2%)
				male	7(17.9%)	9(23.1%)	4(10.3%)	19(48.7%)	
				female	15(34.9%)	14(32.6%)	2(4.7%)	12(26.1%)	

Blood type O correlation analysis

Compared Severe, Non-severe COVID-19 patients to Non-COVID19 with blood group of type A, type B, type AB and type O in COVID19 and Non-COVID19 patients, It indicated that severe COVID19 patients with the blood group of type O compared with non-COVID19 patients was considered statistically significant. ($\chi^2=4.066$, $p=0.044$, $OR=0.380$). (Table 3 ,Figure 3),and patients with the blood group of type O had lower risk of severe COVID19 infection.

Table 3 ABO blood group distribution and correlation analysis in Severe, Non-severe and Non-COVID19 patients.

	a 1	a 2	a 3	a 4	a 5	a 6	a 7	a 8
χ^2	0.625	0.433	-	4.066	0.050	0.011	0.876	0.464
P value	0.429	0.510	0.463	0.044*	0.823	0.916	0.349	0.496
OR	1.429	1.344	1.810	0.380	1.077	0.966	1.617	0.811
95%CI	0.594-3.437	0.561-3.221	0.475-6.892	0.141-1.025	0.564-2.054	0.507-1.839	0.580-4.509	0.444-1.482

Note: p values were obtained by a Chi-square test. *P < 0.05 was considered statistically significant. OR, odds ratio. CI, confidence interval.

Gender distribution and correlation analysis

Compared gender distribution and correlation analysis in ABO blood group of Severe, Non-severe and Non-COVID19 patients. It indicated that severe female COVID19 patients with the type O blood group compared with severe female non-COVID19 patients was considered statistically significant (p=0.049),(Table 4, Figure 4), which showed female with the type O blood had lower risk in deteriorating severe COVID19 infection.

Table 4 Gender distribution and correlation analysis in ABO blood group of Severe, Non-severe and Non-COVID19 patients.

	b 1	b 2	b 3	b 4	b 5	b 6	b 7	b 8
<i>X</i> ²	-	-	-	1.559	1.572	0.213	-	1.899
<i>P</i> value	0.189	1.000	1.000	0.212	0.210	0.654	1.000	0.168
OR	2.667	0.889	1.029	0.486	1.875	1.250	0.875	0.556
95%CI	0.772-9.215	0.235-3.364	0.171-6.188	0.153-1.539	0.687-5.117	0.482-3.240	0.219-3.492	0.244-1.285
continued								
	c 1	c 2	c 3	c 4	c 5	c 6	c 7	c 8
<i>X</i> ²	-	-	-	-	0.603	0.290	-	0.134
<i>P</i> value	1.000	0.201	0.227	0.049*	0.437	0.590	0.173	0.714
OR	0.830	2.417	3.727	-	0.706	0.784	3.261	1.181
95%CI	0.218-3.151	0.683-8.548	0.470-29.534	-	0.293-1.700	0.323-1.901	0.640-16.613	0.484-2.879

Note: p values were obtained by a Chi-square test. *P < 0.05 was considered statistically significant. OR, odds ratio. CI, confidence interval .

COVID-19 infected risk factors

There was no statistically significant of the distribution between Type O and Non Type O (Table5), but there was statistically significant of laboratory indexes, and the group of Type O patients have lower indexes except MCV, MCH (Figure 5).

Table 5 ABO blood group distribution and correlation analysis in Type O and Non Type O of COVID19 patients

	Non-type O	Type O	<i>X</i> ²	<i>P</i> value	OR	95%CI
COVID19(N=138)	97(70.3%)	41(29.7%)				
Non- COVID19(N=82)	51(62.2%)	31(37.8%)	1.518	0.218	0.695	0.391-1.238

Discussion

ABO blood group system is a very stable genetic material, which is located in the long arm three region four band (9q34) of chromosome 9. It is closely related to many disease[8, 13, 14] Davison Glenda M, et al[15] considered the expression of blood group antigens varies across human populations and geographical regions due to natural selection and the influence of environment factors and disease. The red cell membrane is host to numerous surface antigens which are able to influence susceptibility to disease. Liao ,et al [16], suggested that the blood type A, B and AB might not affect susceptibility to norovirus infection. However, blood type O appeared to be more susceptible to norovirus infection. Jing, et al[17]. performed a meta-analysis to investigate whether ABO blood groups were associated with HBV infection. Our team have done a research on correlation between ABO blood groups and incidence of eight kinds of cancers[18]

In order to find out whether there is a correlation between COVID19 and ABO blood group, and how to reduce the risk of infection, OR is odds ratio, also known as excellent potential ratio, when the occurrence of disease is known, compare disease group with non-disease group ,When the exposure of risk factors in the group is different, use the OR for quantitative description. In this paper, chi square test was used to compare the p value and OR value between severe, non-severe and Non-COVID19 patients. Whether the OR value is meaningful depends on p value. when the p value less than 0.05 and OR less than 1, it indicates that it may be a protective factor, and it reduces the risk of the event, On the contrary, if the p value less than 0.05 and OR more than 1, it indicates that it may be a risk factor, and that the risk increase[19, 20]

In our study, the blood group results of COVID19 patients between January 21 and February 20, 2020 were analyzed retrospectively, meanwhile, the Non-COVID19 patients were all returned from Wuhan or had the history of contacting with people returned from Wuhan. contact history was significant difference between the two groups, It may be due to the different epidemic situation in different areas of Wuhan and the different frequency of personal protective activities, but the electronic medical record did not record these information in detail. At the same, we found that patients with COVID19 were generally older than those Non-COVID19, and with the comorbidity of digestive system disease 17 (12.3) vs. 3(3.7), which was considered statistically significant ($\chi^2 = 5.291, p = 0.021$).

The results of this study show that, Blood group distribution in Severe, Non-severe and Non-COVID19 patients are A = B > O > AB, O > A > B > AB, O > B > A > AB, respectively (Table 2). While The distribution of blood group O in the severe group was statistically different from that in the non-COVID19 group, There was a negative correlation with the severity of COVID19, that means the patients with blood group of type O decreased the risk of infection of severe COVID19 ($\chi^2 = 4.066, p = 0.044, OR = 0.380$), but there was no statistical difference in the distribution of other blood groups ($p > 0.05$). we made a further analysis, gender distribution and correlation analysis in Severe, Non-severe and Non-COVID19 patients. Finally, we found the cases of female patients with type O in severe COVID patients was zero, which was significantly different from female non- COVID19 ($P = 0.049$), and there was no statistical difference in other blood groups.

At the same time, we further divided COVID19 patients into type O and non-type O groups, and analyzed the laboratory indexes of the two groups, and found alanine aminotransferase (ALT), Lactate dehydrogenase (LDH), Total CD19⁺B cell ratio(TBCD19) were lower in type O COVID19 patients while had higher value in mean corpuscular volume (MCV), mean corpuscular hemoglobin mch (MCH), have Significant difference between the two groups. ALT is mainly distributed in liver, followed by skeletal muscle, kidney, heart muscle and other tissues, and it is one of the most sensitive indicators of liver damage. LDH is a detectable enzyme in the cytoplasm of nearly all cells in the human body, which is used to detect cell necrosis and tissue destruction [21], and research shows that The relationship between LDH and in-hospital mortality in acute aortic dissection patients is nonlinear. LDH was positively related with in-hospital mortality when LDH is more than 557[17]. Other study show that in the case of idiopathic pulmonary arterial hypertension, patients with high levels of LDH had a low cumulative survival rate[22].CD19 is a common surface marker of all B cells. BC mainly mediates humoral immunity such as anti-infection, MCV, MCH and mean corpuscular hemoglobin concentration (MCHC) often show the pathological changes of red blood cells from different sides, which has certain value for the diagnosis of anemia. It is suggested that the damage of liver and myocardium in COVID19 patients with blood type O is less serious than that in patients with non-type O.

Some limitations could not be avoided in this study. To date, the association of blood group and COVID19 therefore remains a gap area of biological research and further large population studies should to be done to analyze all polymorphic blood groups which are required to add further knowledge to this subject.

Conclusion

In summary, the laboratory indexes were significantly difference between type O and non-type O COVID-19 patients which indicated that patients with the blood group of type O had relatively lower risk of COVID19 infection, especially, female with the type O blood had lower risk in deteriorating severe COVID19 infection. We should concern more to the patients with non-type O blood to minimize the risk of COVID19 infection.

Declarations

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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Contributors: Contribution: MP and SH and SZ conceived the study and wrote the study protocol; MP wrote the first draft of the manuscript, which was subsequently edited by SH; and all authors entered patient information, analyzed data, and participated in writing and editing of the manuscript.

Ethics declarations

Ethical approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of the Zhejiang Taizhou Hospital affiliated to Wenzhou Medical University (K20200112), and with the Helsinki declaration or comparable ethical standards.

Consent for publication

Not applicable.

Competing Interests statement

None declared

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Figures

Type O and Non-type O in COVID19 patients

Figure 1

Comparison of laboratory indexes between type O and non-O in COVID19 patients Note: The data represents (Mean±SD), p values were obtained by Mann-Whitney U test. P values indicate differences between type O and Non-type O COVID19 patients, P < 0.05 was considered statistically significant. * p < 0.05, **p < 0.01. mean corpuscular volume (MCV), mean corpuscular hemoglobin mch (MCH), alanine aminotransferase (ALT), Lactate dehydrogenase (LDH), Total CD19+B cell ratio (TBCD19)

Figure 2

Gender distribution and correlation analysis in ABO blood group of Severe, Non-severe and Non-COVID19 patients.

Figure 3

ABO blood group distribution and correlation analysis in Severe, Non-severe and Non-COVID19 patients.

Figure 4

ABO blood group distribution in Severe, Non-severe and Non-COVID19 patients.

Figure 5

The flowchart of COVID-19 confirmed and non-COVID-19 cohort. The majority of suspected patients were being diagnosed as confirmed COVID-19 positive patients with CT and ET-PCR then regrouped confirmed cases into severe and non-severe patients.