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Research Article

PROBABILITY OF COVID-19 IN ABO BLOOD TYPE DURING SECOND WAVE IN SOUTHERN RAJASTHAN, INDIA

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ABSTRACT

Objectives: Along the course human history of scientific research, the severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) is the most concerning global health problem. Second wave of COVID-19 has adversely affected India. However, India embarked on its immunization program on January 16, 2021, operating 3006 vaccination centers onset Covaxin and CoviShield. This study aimed to ascertain if there is an association amidst ABO blood type and probability of COVID-19 infection in wave.

Methods: This is analytical and observational study conducted on 713 SARS-COVID-19-positive patients of a known ABO blood type, who attended outpatient department and inpatient department during March 26–May 20, 2021, in tertiary care hospital Udaipur (Raj.) Serum inflammatory markers were evaluated by Cobas 6000.

Results: Out of the 713 patients who were tested positive, 15.56% was blood group Type A, 19.91% was blood group Type B, 13.65% was blood group Type AB, and 46.28% was blood group Type O. On statistical analysis, there were positive association between O^+ blood type and peak inflammatory marker (interleukin-6 and D-Dimer). Patients with blood Type O who received a test were more likely to test positive and blood Type B+, A+, A+,AB+,O-,A-,B-, and AB- were less likely to test positive.

Conclusion: The present study shows an evidence for interrelation between ABO blood groups and SARS-COVID-19. Reported infection prevalence is moderately increased among O^+ blood type individuals. Determination of level of inflammatory markers might prove to be helpful to clinicians so as to keep track of severity of infection and evaluate the prognosis of SARS-COVID-19 with specific ABO blood groups.

Keywords: ABO blood group, COVID-19, D-Dimer, Inflammatory markers, Udaipur.

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INTRODUCTION

Second wave of COVID-19 (severe acute respiratory syndrome corona virus 2 [SARS-CoV-2]-B.1.617.2 Variant) affected India adversely during February 2021–May 2021. Millions of people lost their near and dear ones during this period due to COVID-19. The situation got so worse that in some cases, the COVID-19 claimed the lives of entire families, erasing their existence completely [1]. While India has began Anti-COVID vaccination in January 2021, in first drive of vaccination in first phase, 1,65,714 individuals were immunized on the opening day of vaccination program [2]. In context of Rajasthan Government, in Udaipur, nine centers were planned for vaccination. Second phase of vaccination started from March 01, 2021, for the age group 45–60 years for people with and without comorbidities [3].

The second wave not only affected the elderly, but hit the younger population more gravely. Udaipur, "City of Lakes" situated in Southern part of Rajasthan was also not spared from the adverse effects of the second wave of COVID-19. Even though sanitization, hand hygiene and wearing mask became a part of daily life, yet the number of infected increased exponentially from 1st week of April 2021. As per data from JHU CSSE COVID-19 on April 01, 2021, 1350 cases were newly reported positive and suddenly till April 30th, this number had reached to 17,155 in only a month in Rajasthan. An average of seven deaths were reported per day and 21.4% patients were reported positive for SARS COVID-19 [4]. In April 2021, 21,448 COVID-19-positive patients were reported; out of them, 288 patients were expired. Case fatality ratio was 1.34% in April. In Month of May, 20,843 patients were reported positive for COVID-19; out of them, 731 were expired. Case fatality ratio was reported 3.5% in May 2021 in Udaipur, Rajasthan [5]. According to the state health department data on Sunday (April 11, 2021), 5105 positive cases were reported in the state, among which Udaipur district noted the maximum number of positive cases (864). This was the time when 30% of the positive cases were reported from Udaipur, making it the COVID-19 hotspot of Rajasthan [6].

According to a Survey by CSIR, people with AB and B+ blood groups have higher risk of contracting the COVID-19 Infection, while on the contrary; people with blood Type O+ is less likely to get COVID-19 infection. As per report, it was demonstrated that O+ blood type have better immunity compared to other blood types [7,8]. The report also said that it is only a survey, as there is still no authentic publication which showed actual data. There were only few studies from around the globe which showed a interrelation among ABO blood types and SARS-COVID-19. Due to the lack of aforementioned literature, we have planned this study in Udaipur, Southern part of Rajasthan, India.

METHODS

This is an analytical and observational study. The study was started with the permission of Institutional ethical committee ref. no. –GU/HREC/EC/2021/1842. We have enrolled 713 patients, attending Geetanjali Medical College and Hospital, Udaipur, for treatment, from last week of March to May 30, 2021, who were reported positive for SARS-COVID-19. Then, we divided these SARS-COVID-19-positive patients into two groups: Group1 – Hospitalized Positive Patients (Male

and Female), Group 2 – patients in Home Isolation (Male and Female). Further, we have divided them according to blood groups into O^+, A^+ B^+, AB^+ A^-, B^-, and O and according to history of vaccinated and non-vaccinated. Patients from age group 18 to 85 years, tested positive for COVID-19, and having no other systemic illness or any comorbidities were included in the study. Patients <18 years and more than 85 years and women who were expecting a baby were not included in this research work. Patients with some comorbidity such as diabetes, hypertension, thyroid disorder, alcoholic cirrhosis, cancer, or with any systemic illness and who were tested negative for COVID-19 were also excluded from this study. Inflammatory markers of the subjects were analyzed by fully automated Cobas-6000 and D-dimer by AQT-90. We have analyzed all the data statistically by Microsoft Excel and online software Graph Pad "Prism."

RESULTS

The present study is an observational and analytical study. We have enrolled 713 patients, who were reported positive for COVID-19 in second wave. Out of them, 350 were hospitalized and 363 patients remained in home isolation. Then, we categorized them as per history of ABO types. In this study, we have found 50.41% and 41.98% probability of patients from blood group O-positive. In this study, we have reported 46.28% of probability that patients of O-positive blood group and 13.65% from AB-positive blood group were reported positive for COVID-19 in second wave. (Tables 1 and 2, Fig. 1) show male patients who were reported positive for COVID-19 in second wave. About 47.10% pf male patients were O-positive and 12.94% were AB-positive blood group. Case fatality ratio for male patients was 0.82% specific to a single tertiary care hospital (Figs. 2 and 3). Our results concluded lesser risk of infection in Rh-negative blood types. Table 3 represents positive COVID-19 female patients in second Wave, 45.42% of maximum probability of females were O-positive and minimum probability of blood group AB-positive. Case fatality ratio for females was 2.0% (Fig. 3).

Table 4 shows distribution of these subjects as per age group and probability of ABO blood type. In age group 18–45 years, we have found 45.75% of patients from O-positive blood group and 14.95% in AB-positive blood type. Case fatality ratio for 18–45 years patients was 1.7%. It means second wave of COVID-19 affected younger populations more than older. Table 5 shows probability of blood groups in 45–90 years of age group. We have found 47.54% of patients in O-positive and 11.69% in AB-positive blood type. Case fatality ratio for this group was only 0.7% (Fig. 3).

Then, we have divided patients as per history of vaccination (CoviShield and Covaxin). The results were really surprising that patients with blood group O-positive tested positive for COVID-19 after both doses of vaccine. Probability of infection in patients was 14.2% in hospitalized and 57.14% in home isolated patients (Table 6). Then, we have compared the level of serum inflammatory markers in home

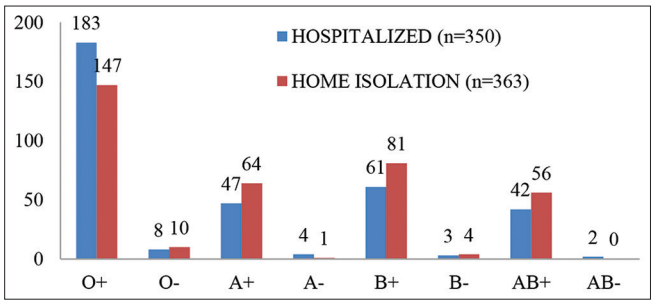

Fig. 1: Probability of total COVID-19 patients (hospitalized home isolation) in second wave in India

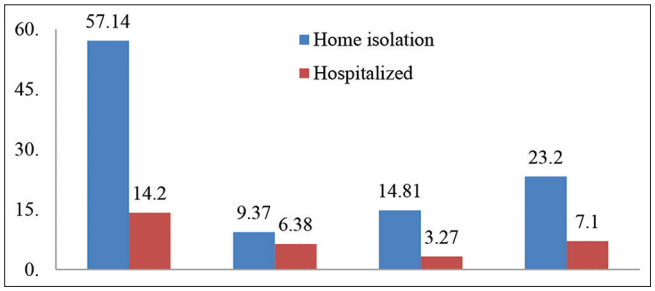

Fig. 2: Vaccinated COVID-19-positive subjects hospitalized and home isolation in second wave

Table 1: Probability of total COVID-19 patients (hospitalized+home isolation) in second wave in India

Blood group (ABO)	Hospitalized (n=350)	Home isolation (n=363)	Percentage			CFR
			Hospitalized	Home isolation	Total	
O+	183	147	50.41	41.98	46.28	1.4%
O-	8	10	2.2	2.85	2.52	
A+	47	64	12.93	18.28	15.56	
A-	4	1	1.1	0.28	0.7	
B+	61	81	16.79	23.1	19.91	
B-	3	4	0.82	1.14	0.98	
AB+	42	56	11.57	16	13.65	
AB-	2	0	0.54	0	0.28	

Table 2: Total number of male patients (hospitalized+home isolation) with ABO type

Blood group (ABO)	Hospitalized (n=214)	Home isolation (n=149)	Percentage			CFR
			Hospitalized	Home isolation	Total	
O+	109	62	50.93	41.61	47.10	0.82%
O-	2	6	0.93	4.02	2.203	
A+	29	28	13.55	18.79	15.7	
A-	3	1	1.40	0.67	1.101	
B+	40	30	18.69	20.13	19–28	
B-	3	1	1.40	0.67	1.101	
AB+	26	21	12.14	14.09	12.94	
AB-	2	0	0.93	0	0.55	

Table 3: Total number of female (hospitalized+home isolation) with ABO type

Blood group (ABO)	Hospitalized (n=136)	Home isolation (n=214)	Percentage			CFR
			Hospitalized	Home isolation	Total	
O+	74	85	54.41	39.71	45.42	2.0%
O-	6	4	4.411	1.86	2.85	
A+	18	36	13.23	16.82	15.42	
A-	1	0	0.73	23.83	0.28	
B+	21	51	15.44	1.40	20.57	
B-	0	3	0	0	0.85	
AB+	16	35	11.76	16.35	14.57	
AB-	0	0	0	0	0	

Table 4: Distribution of total COVID-19 positive subjects as per age group (18–45 years of subjects)

Blood group (ABO)	Hospitalized (n=190)	Home isolation (n=258)	Percentage			CFR
			Hospitalized	Home isolation	Total	
O+	102	103	53.68	39.92	45.75	1.7%
O-	3	10	1.57	3.87	2.9	
A+	26	63	13.68	24.41	19.66	
A-	2	4	1.05	1.55	1.33	
B+	26	38	13.68	14.72	14.28	
B-	2	1	1.05	0.38	0.66	
AB+	28	39	14.73	15.11	14.95	
AB-	1	0	0.52	0	0.22	

Table 5: Distribution of total COVID-19-positive subjects as per age group (45–90 years of subjects)

Blood group (ABO)	Hospitalized (n=159)	Home isolation (n=106)	Percentage			CFR
			Hospitalized	Home isolation	Total	
O+	81	44	50.94	41.5	47.54	0.7%
O-	5	1	3.14	0.94	0.22	
A+	21	19	13.2	17.92	15.09	
A-	2	o	1.25	0	0.75	
B+	35	25	22.01	23.58	22.64	
B-	1	0	0.62	0	0.377	
AB+	14	17	8.8	16.03	11.69	
AB-	0	0	0	0	0	

Table 6: Vaccinated COVID-19-positive subjects hospitalized and home isolation in Second wave

ABO blood type	Home isolation	Percentage	Hospitalized	Percentage
O+	84	57.14	26	14.2
A+	6	9.37	3	6.38
B+	12	14.81	2	3.27
AB+	13	23.2	3	7.1

isolated and hospitalized patients for each blood type. We have found a statistically significant difference for all markers in each blood type with history of home isolation and hospitalization (Table 7, Figs. 4 and 5).

Table shows highest number of O+ patients 183 (50.41%) in hospitalized and 147 (41.98%) in home isolation. Case fatality ratio was 1.4% in subjects of a single tertiary care hospital who were enrolled for the study, Udaipur, Rajasthan, for total COVID-19 patients in second wave.

Table shows 50.93% of male in hospitalization from O^+ group and 41.61% in home isolation out of 363 male patients who were tested positive for COVID-19. For male patients case, fatality ratio was 0.82%, out of 363 who were tested positive for COVID-19 in Second wave.

Table shows 54.41% of hospitalized and 39.71% of female were in home isolation out of 350 O+ females. While minimum number of

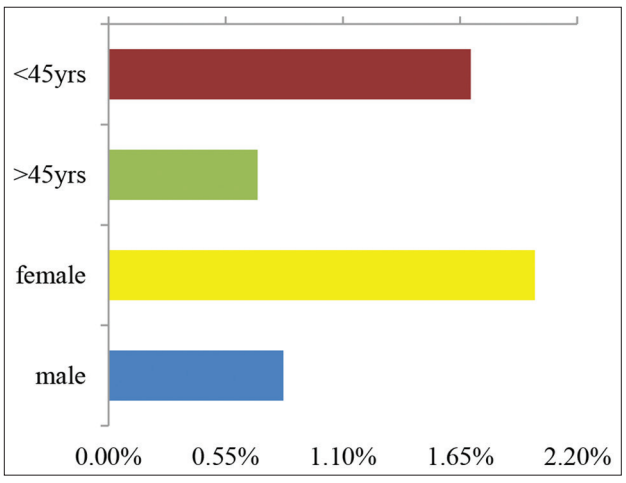

Fig. 3: Case fatality ratio of COVID-19-positive during second wave

female were reported from AB+ blood type, who were tested positive for COVID-19 in second wave by delta variant. Case fatality ratio for females were 2.0%, out of 350 females who were tested positive for COVID-19 in second wave.

Table shows that in second wave, highest number of COVID-19-positive patients were reported from O + group in age group 18–45 years in age.

Table 7: Comparative level of serum inflammatory markers in hospitalized and home isolation, ABO blood type COVID-19-positive patients in second wave

Parameters	O+ (Mean±SD) (Hosp n=183)	O+ (Mean±SD) (Home iso n=147)	B+ (Mean±SD) (Hosp n=61)	B+ (Mean±SD) (Home iso n=81)	A+ (Mean±SD) (Hosp n=47)	A+ (Mean±SD) (Home iso n=64)	AB+ (Mean±SD) (Hosp n=42)	AB+ (Mean±SD) (Home iso n=56)
D DIMER (µg/L)	10.06±9.72	5.43±5.15	3.48±1.58	4.68±3.9	4.38±2.69	2.20±0.702	2.56±3.48	3.77±1.28
t-test	5.2160		2.2656		6.2109		2.3980	
p-value	0.0001		0.0250		0.0001		0.0184	
IL-6 (pg/ml)	77.24±25.9	15.09±3.96	28.49±22.25	9.58±4.11	66.03±17.58	13.46±3.12	31.6±23.55	14.6±9.85
t-test	28.8161		7.4895		23.4648		4.8700	
p-value	0.0001		0.0001		0.0001		0.0001	
LDH (U/L)	404.84±197.68	160.1±32.79	325±138.9	174.2±19.56	479.92±334	154.96±33.2	433.3±69.2	153.05±21.08
t-test	14.8433		9.6602		7.7442		28.6294	
p-value	0.0001		0.0001		0.0001		0.0001	
CRP (mg/L)	38.00±13.49	25.27±5.32	29.18±15.61	15.21±3.21	74.41±8.31	26.27±6.38	59.49±9.7	27.35±5.89
t-test	10.7849		7.8458		34.5306		20.3170	
p-value	0.0001		0.0001		0.0001		0.0001	
PCT (ng/ml)	0.867±1.2	0.11±0.1	0.177±0.45	0.12±0.15	34.88±12.3	0.25±0.5	4.24±1.27	0.23±0.2
t-test	7.62		1.06		22.53		23.28	
p-value	0.0001		0.2886 NS		0.0001		0.0001	
Ferritin (ng/ml)	416.36±145.07	157.87±51.5	314.61±48.34	151.09±20.7	424.8±163.01	148.48±21.42	110.16±56.96	109.51±24.0
t-test	20.58		27.3225		11.4302		0.0769	
p-value	0.0001		0.0001		0.0001		0.9389	

NS: Non significants, PCT: Procalcitonin, IL: Interleukin, LDH: Lactate dehydrogenase

Fig. 4: Serum D-dimer in hospitalized and home isolation patients

Fig. 5: Serum interleukin-6 in hospitalized and home isolation patients

It was 39.92% in home isolation and 53.68% in hospitalization. About 13.68% of patients were reported from both A+ and B+ blood type in hospitalization, while in home isolation, B+ blood type was more in comparison to A+ blood type. Case fatality ratio was 1.7% for subjects <45 years in age out of 448, who reported positive for COVID-19 in second wave.

Table shows in age group more than 45 years 50.94% of patients were hospitalization and 41.5% in home isolation from O+ blood type and 8.8% hospitalized and 16.03% in home isolation from AB+ blood type. Case fatality ratio was 0.7% for subjects more than 45 years in age out of 265, who reported positive for COVID-19 in second wave.

Table shows that 57.14% in O + and then AB+ 23.2% were reported positive after vaccination in home isolation while, 14.2% and 7.1% in hospitalization after vaccination in respective blood group O+ and AB+ in ABO blood type.

Table shows a significant difference in various inflammatory markers in ABO blood type between hospitalized and home isolation patients who were tested positive for COVID-19 in second wave.

DISCUSSION

This research work was carried out in a tertiary care institute and hospital on patients who were reported positive for COVID-19 during second wave in Udaipur, Rajasthan. Whether blood group is

related with risk of COVID-19 infection or not was investigated. We estimated higher risk deviations among Rh blood group than among ABO blood groups, while Rh-negative people were at a lesser risk of all three consequences. Corresponding affirmation for preventive associations between Rh negative blood types and COVID-19 infection were also found. In this observational study, we have found maximum number of cases who tested positive for COVID-19 in blood group $O^{+,}$ while minimum number of cases in AB^{+}. Our results were not in support of survey, done by CSIR, which reported that blood group O^{+} had the minimum chances of COVID-19 infection. According to survey, O + group had good immunity in comparison to others ABO blood groups. Hence, they have minimum chances of infection or if infected, they were asymptomatic or had less severe symptoms [4,6]. The ABO blood groups are unevenly among various ancestries as it has a very versatile genetic make-up [10]. For example, ABO and Rh groups randomly and unevenly spread among various ethnicity and racial groups.

Another study showed that individuals with A blood Groups faced lesser likelihood of intubation and loss of life in relation to O blood groups, while AB blood groups faced a larger risk for development of both the consequences. Conversely, it was discovered by them that blood group B was encountered with increased risk of being intubated while being at a lesser probability of mortality in comparison to O blood groups [11]. The results of our study were inconsistent with an interrelation concluded for SARS-CoV-1, which depicted that SARS patients with blood groups O were a minority.

As far as we know, this is the first scientific research work on blood group association, set of serial inflammatory markers and chances of COVID-19 infection during second wave of COVID-19 in Udaipur, Rajasthan. Hence, we do not have additional data for comparing our results with others.

We divided the subjects into hospitalized and home isolation criteria. In hospitalized 183 patients with O^{+} out of 350 and in home isolation out of 363, 147 patients were reported with blood group $O^{+,}$ There were no major differences between number of hospitalized patients and in home isolation. Even in our study, we have enrolled the patients who were vaccinated for anti-COVID vaccine and tested positive for COVID-19. There is also a large number of patients with blood Group O+. Although the mode of action of ABO blood group in COVID-19 infection has not been clarified yet, still we have put forth our findings based on deductions of the previous researchers. Although antigen associated with ABO blood group is expressed in epithelial cells of the airway, alveoli, and body fluids, on the membrane of erythrocytes [12]. Initially, it was believed that the genetic susceptibility associated with glycoprotein of blood group work mostly through invasion mechanisms by binding receptor mediated affinity. Similarly, it was proven by other studies that ABO antigens are the proper receptors for a few infectious microorganisms [13,14]. Still the mechanism behind of this risk association with ABO blood group has not become clear. Meanwhile, our results convey that individuals belonging to blood type AB+ possess higher bodily protection mechanisms to minimize the probability of COVID-19 infection. Further research is needed with a larger sample size for the same. Our results are also mostly in consistence with the results reported by Zhou *et al*. [15] Our conclusions are derived on the basis of on data collected as a part of hospital care in the duration of the early phase of pandemic's second wave. Then, we have compared the level of inflammatory markers in ABO blood groups. Our results are consistent with others studies which have depicted a higher pro-inflammatory serum cytokine levels in the COVID-19-infected patients. Moreover, anti-inflammatory agents for COVID-19 therapy spotlight the utmost important role of inflammation in the development of SARS-COVID-19 infection [16,17]. C-reactive protein (CRP) level was positively related the development of severe consequences in the infection of COVID-19. Inflammatory markers, notably CRP, procalcitonin, interleukin-6, lactate dehydrogenase, and Ferritin, were found to be in a directly proportional correlation with the severity of SARS-COVID-19 infection with a specific blood group.

Limitation of study

Selection bias is a fundamental drawback of our research work. This is not universal study, it is only area specific even a single institute-based study. Further research is required for better understanding of any potential residual confusion as a result of ancestry, not taken into account by race and ethnic origin.

CONCLUSION

In this research, we found evidence that there is link among ABO and Rh blood types and SARS-COVID-19. We found that infection prevalence is moderately increased among O blood groups and amidst Rh-positive individuals and measuring of inflammatory markers could be useful for clinicians in monitoring and assessing the extremity and prognosis of COVID-19 with specific ABO blood groups.

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CONFLICTS OF INTEREST

None.

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