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Original Research Article

Association of ABO and Rh blood group with susceptibility, severity and mortality of coronavirus disease (COVID-19) - A tertiary hospital based study in Gondia Maharashtra, India

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ABSTRACT

Background: Couple of years passed since the first inception of SARS-CoV-2 coronavirus-2; (COVID-19) from Wuhan China, spreading its tentacles across the world resulting in a pandemic situation of modern times, leading to numerous mortal deaths across the world. Since classical blood groups ABO and Rhesus blood groups are linked with various viral diseases the objective of the study was to find out if any association of susceptibility, severity and mortality of exists after covid -19 with classical blood group ABO and Rhesus blood.
Objective: The main objective of this study was to find if any association of susceptibility (vulnerability) of COVID-19 infection and ABO & Rhesus blood type among Indian population.
Materials and Methods: A tertiary hospital based study conducted retrospectively among SARS-CoV-2 (COVID-19) infected hospitalized patients above the age of 18 years of both sexes. A total of 583 (Five hundred eighty-three) COVID-19 positive adult hospitalized patients were included for the study and equal number of non COVID-19 adult patients was taken as a comparison group. Statistical significant was tested using Chi-square test.
Results: The findings revealed a higher number of COVID-19 patients belonging to the AB blood group whereas it was least in type O blood group. No statistically significant association was obtained pertaining to susceptibility, severity and mortality of COVID-19 infection with classical blood groups ABO and Rh types.
Conclusion: The susceptibility, severity and mortality related to COVID-19 were not associated with classical ABO blood groups and Rh types.

1. Introduction

Many waves erupted after the first inception of COVID-19, when each time it showed hope that the pandemic is over a new wave erupted with new challenges and loss of life.

ABO blood group and Rhesus blood group system are researched most and applied clinically among all blood group types, mainly for its easy identification of phenotypes.[1] Corona virus disease (COVID–19) resulted from corona virus-2 (SARS – CoV -2) , that emerged in December 2019 caused a public health emergency and led to almost collapse of health care and economic system world wide.[2]

Many diseases have been manifested associated with COVID-19, affecting respiratory, gastrointestinal, Cardiovascular and hematological systems.[3]

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Researchers have associated classical blood group ABO and Rhesus blood group and a number of different infectious diseases like middle east respiratory syndrome corona virus, hepatitis B Virus (HBV), and severe acute respiratory syndrome corona virus. Studies from various parts of the world including China have concluded the association between ABO and Rhesus blood group with SARS – CoV -2 infection.[4–6] Though the under lying mechanism is still unclear, it may be that genetically encoded blood group antigen may be a pre-disposing factor for SARS – CoV–2 infection.

A study also suggests that there is a association of cross – replicating signal at 9q 34.2 locus, which coincides with the ABO blood group locus.[7,8] Few studies also have examined the association between severity of COVID–19 infections and classical blood groups. Many researchers studied the association of blood group type with mortality of COVID–19 infected patients. However, the cause of association and severity of COVID-19 diseases is unclear still.

Some studies concluded a risk of COVID – 19 infection (susceptibility) with A blood group, while giving a low risk status of COVID–19 infections to person having O group blood.[9] There are also some reviews that confers blood group A individuals are more susceptible to COVID-19, while AB group having low risk of SARS CoV–2 infection.[10,11] Few studies also showed Rhesus (D) positive blood group have increased risk of COVI -19 and so also mortality.[12]

Distribution of classical ABO and Rhesus blood group differs in relation with ethnicity and very few studies have been done with Indian population where blood group O & B are prevalent, hence the present study was undertaken to find whether COVID-19 disease associated with susceptibility, mortality and severity in relation to classical ABO and Rhesus blood group type.[12]

2. Objectives

2.1. Primary objective

This study was to find if there is an association of susceptibility (vulnerability) of COVID-19 infection with ABO and Rhesus blood type in adult COVID-19 positive patients admitted in the tertiary care center Gondia Maharashtra

2.2. Secondary objective

To find out if there is an association of severity of COVID-19 disease with ABO & Rhesus blood type.

2.3. Additional objective

To find out any COVID-19 associated mortality in association with ABO & Rhesus blood type.

3. Material and Methods

3.1. Design of the study

A hospital based cross-sectional study with a comparison group conducted retrospectively at tertiary care center Gondia, Maharashtra India. The study was conducted among adult patients, infected with COVID - 19 and admitted for treatment in the hospital.

3.2. Inclusion criteria

SARS-CoV-2 (COVID-19) infected hospitalized patient above the age of 18 years. The patients were confirmed positive of COVID - 19 by laboratory assay of reverse transcriptase polymerase chain reaction (RT-PCR).

All adult patients having documented ABO & Rhesus blood type and proper documentation regarding their treatment protocol.

3.3. Exclusion criteria

Those patients hospitalized with COVID-19 infection but having co-morbidities like Diabetes mellitus, hypertension, chronic renal diseases, coronary artery disease, hypothyroidism, chronic obstructive pulmonary disease (COPD) and liver diseases. All patients having no documented classical ABO and Rhesus blood type were excluded.

3.4. Data collection

Data was obtained from the hospital record of the tertiary care center Gondia Maharashtra India.

The following data was obtained: demographic data like age, sex and contact number was extracted from the hospital records. Date of admission in the hospital, co-morbidities, date of ICU admission, date of discharge, in hospital mortality if any and their blood groups was noted in a preformed data collection sheet.

3.5. Study period

The data was extracted from the period of October 2020 to October 2021.

Total of 5240 COVID-19 positive patients were admitted during this period out of which 583 (five hundred eighty-three) COVID-19 positive patients were included in this study.

A comparison group of equal number was formed from non COVID-19 infected hospitalized adult patients' records approximately admitted around the same time duration.

The patients were grouped into grade of severity on basis of criteria as per "Centers for Disease Control and Prevention" (CDC) and WHO guidelines.[13,14]

Grade 1: Asymptomatic patients those who showed no signs and symptoms and were in their usual health were

discharged from hospital after 2-3 days.

Grade 2: Mild symptomatic COVID -19 patients: Where symptoms require no oxygen supplements or any treatment were discharge after treatment after 5-7 days.

Grade 3: Severe COVID-19 symptomatic patients: Those complained with dyspnea, respiratory rate thirty breath per minute or higher, oxygen ≤ 93% saturation on normal room air, or chest X-ray findings which were consistent with pneumonia or a combination of all these. Those were the patients who required to be shifted to the ICU for treatment.

Grade 4: Critical COVID-19 patients: Patients requiring intubation and invasive ventilation for respiratory failure, septic shock, or multi-organ dysfunction or failure any one.

3.6. Analysis plan

Data entry was made in Microsoft Excel 2013. Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp, Armonk, NY, USA) was used for statistical analysis. After normality adjustments using the Wilk-Shapiro test, quantitative variables were presented as mean ± standard deviation (SD) for normal distribution.

Statistical significance of ABO and Rhesus blood groups with COVID -19 susceptibility, severity and mortality was analyzed using Chi-square test. Bivariate analysis was done to generate odds ratio (OR) to study the strength of association of ABO and Rhesus blood groups and susceptibility and severity to COVID-19. Odds ratios were reported with 95% confidence intervals (CI). P-values of less than or equal to 0.05 were considered statistically significant

3.7. Ethical Issue

This study was reviewed and subsequently permission was approved by institutional human ethics committee, tertiary care center Gondia Maharashtra India.

Telephonic consent was obtained from the patients where ever possible or verbal consent was obtained from their family members.

4. Results

A total of 583 (Five hundred eighty-three) COVID-19 hospitalized patients was included for this study and equal number of non COVID-19 patients was taken for comparison group.

Out of 583 COVID - 19 positive patients 293 (Two hundred ninety-three, 50.27%) were male and 290 (Two hundred ninety, 49.74%) were female patients. The mean age of the patients was 50.70 ± 18.32 years as shown in Table 1.

The majority of blood group in descending order for COVID19 (+) group were O blood group 199 patients counts (34.1%), B blood group 185 patients counts (31.7%), A blood group 151 counts(25.9%) and AB blood group 48 patients counts (8.23%) in COVID-19 positive group .572 (98.1%) were Rhesus positive and 11 (1.8%) Rhesus negative patients, as shown in Table 1.

In comparison group, out of 583 COVID-19 (-) patients 351 (Three hundred fifty-one, 54.03%) were male and 268 (Two hundred sixty-eight, 45.96%) were female. The mean age of the patients was 49.37 ± 16.24 years as shown in Table 1.

In the comparison group, blood group distribution was O group 208 (35.6%), B blood group184 (31.5%), A group 146 (25.0%), AB 45(7.7%), Rhesus positive were 569 count (97.5%) and 14 (2.4%) were Rhesus Negative.

4.1. Association of blood group and vulnerability (susceptibility) to COVID-19

Chi- square test was conducted for ABO & Rhesus blood type and COVID-19. The result showed that there was no statistically significant association between any ABO and Rhesus blood type with COVID-19 infection. Though none of the blood group showed statistically significant association of susceptibility, still vulnerability to COVID-19 infection was observed in some blood group as shown in Table 2.

In AB blood group count in COVID-19 positive group n=48 (8.23%) while in respective comparison group the count was n=45 (7.7%). (χ2=0.105, odds ratio, 1.07 (95% CI: 0.7–1.63); p = 0.74).

A blood group shows a greater number of COVID-19 detected patients n=151, (25.9%) then in respective comparison group n=146, (25%) (χ2=0.113, odds ratio, 1.04 (95% CI: 0.8–1.3); p = 0.73).

COVID-19 positive count n=185 (50.1%) in B blood group while in respective comparison group it was n=184 (49.9%). (χ2=0.004, odds ratio, 1.008 (95% CI: 0.78–1.29); p = 0.95).

COVID-19 positive group the patients count was n=199 (48.9%) in O blood group while in respective comparison group the count was n=208 (51.1%). (χ2=0.36, odds ratio, 0.78 (95% CI: 0.35–1.73); p = 0.54).

In Rhesus positive group the COVID-19 positive patients were n=572 (50.1%) while in comparison group n=569 (49.9%). In Rhesus negative group the COVID-19 patients were n=11 (44.0%) while in comparison group n=14 (56.0%). (χ2=0.306, odds ratio, 1.40 (95% CI: 1.40–0.42); p = 0.58).

4.2. Blood group association with severity of COVID-19

COVID Positive patients getting admitted to intensive care unit (ICU) was taken as a benchmark of severity of COVID-19. The association of ABO and Rhesus blood groups and COVID-19 severity was analyzed by distributions of COVID-19-infected individuals admitted in ICU (COVID+ ICU+) and those not requiring ICU admission (COVID+

Table 1: Demographic and blood group distributions of the study participants

	COVID – 19 Positive group	**COVID – 19 Negative (Comparison group)**
n = 583		n = 583
Mean age	50.70	49.37
± SD	± 18.32	±16.24
Gender		
Male	293 (50.27%)	351 (54.03%)
Female	290 (49.74%)	268 (45.96%)
Blood Group		
A	151 (25.9%)	146 (25.0%)
B	185 (31.7%)	184 (31.5%)
AB	48 (8.23%)	45 (7.70%)
O	199 (34.1%)	208 (35.6%)
Rh (+)	572 (98.1%)	569 (97.5%)
Rh (-)	11 (1.8%)	14 (2.4%)

Table 2: Association of susceptibility of COVID – 19 among different blood groups.

Blood groups	**COVID positive group**	**Comparison group (COVID negative)**	χ**2**	**P value**	**Odd ratio**	**CI 95%**	
						lower limit	**upper limit**
A	N=151 25.9%	N=146 25.00%	0.113	0.737	1.046	0.804	1.362
AB	N=48 8.23%	N=45 7.70%	0.105	0.746	1.073	0.702	1.639
B	N=185 31.7%	N=184 31.50%	0.004	0.95	1.008	0.787	1.29
O	N=199 34.1%	N=208 35.60%	0.306	0.58	0.934	0.734	1.189
Rh positive	N=572 98.1%	N=569 97.50%	0.368	0.544	0.782	0.352	1.736
Rh negative	N=11 1.88%	N=14 2.40%					

Table 3: Association of severity of COVID – 19 among different blood groups

Blood group	**ICU admitted**	**Non-ICU admitted**	χ**2**	**P value**
A	N=79 52.30%	N=72 47.60%	0.154	0.695
AB	N=32 66.70%	N=16 33.30%	3.544	0.06
B	N=91 49.20%	N=94 50.80%	2.206	0.138
O	N=111 55.70%	N=88 44.20%	0.531	0.466
Rh positive	N=308 53.80%	264 46.20%	0.306	0.58
Rh negative	N=5 45.50%	N=6 54.50%		

Table 4: Association of mortality of COVID – 19 disease among different blood groups

Blood groups	Death	Cured during hospital stay		
A	N=35 23.20%	N=116 76.80%	$\chi 2$ =0.187	
AB	N=10 20.80%	N=38 79.20%		
B	N=44 23.80%	N=141 76.20%		
O	N=46 23.10%	N=153 76.90%		
Rh negative	N=02 18.20%	N=09 81.80%	$\chi 2$ =0.156	P value=0.693
Rh positive	N=133 23.30%	N=439 76.70%		

ICU−). The two groups' distribution was shown in Table 3. On analyzing of Chi-square test of the blood groups applied on one-vs.-all the result showed no statistically significant difference P>0.05. The severity of COVID-19 in different blood group is shown in Table 3.

The severity of COVID-19 results showed that AB blood group type have more severe cases (ICU+), n=32 (66.7% , $\chi 2$=3.54, p=0.06), O blood type n=111(55.7% , $\chi 2$=0.53, p=0.46), A blood group type n=79 (52.3% , $\chi 2$=0.154, p=0.69), and B blood group type n=91(49.2% , $\chi 2$=2.20, p=0.13)

Rhesus positive blood type was more severe than Rhesus negative type. Rh positive N=308 (53.8%), Rhesus negative N=5 (45.5%) ($\chi 2$=0.30, p=0.58) as shown in Table 3. The result showed no statistically significant association of ABO and Rhesus blood groups and severity of infection. Still our results showed AB blood group has more severe patients' counts.

4.3. Mortality association and blood group type

Distribution of blood groups, when compared between recovered and deceased COVID-19-infected patients, the results showed no statistical significant association with the ABO and Rhesus blood groups, as shown in Table 4.

Chi square test showed no statistically significant result of association between ABO and Rhesus blood group and of COVID-19 positive hospitalized patient with respect to mortality.

Mortality rate among different blood group types are, A group n=35(23.2%), AB blood group n=10 (20.8%), B blood group n=44 (23.8%), O blood group n=46 (23.1%) ($\chi 2$=0.187, p=0.980) as shown in Table 4.

Rhesus positive blood group had 23.3% mortality rate (n=133) & Rhesus -negative blood group had mortality rate of 18.2% (n=02) as ($\chi 2$=0.15, p=0.69) as shown in Table 4.

5. Discussion

Present study was conducted to investigate the association of ABO and Rhesus blood groups on susceptibility of corona virus disease, its severity and mortality among population admitted in government tertiary care center Gondia Maharashtra India.

A total of 583 covid-19 positive adult patients having no co-morbidity were recruited for the study. In COVID-19 positive patients, in our study result it was observed that AB group has the most vulnerability to SARS-CoV-2, followed by A group and group B whereas group O had a lower risk of infection.

Our study results also showed that Rhesus positive blood group was more prone to SARS-CoV-2 than Rhesus negative blood group.

Though our study results, did not confirm the susceptibility of SARS-CoV-2 and ABO, Rhesus blood group statistically as significant.

Liu et al studied on 265 SARS-CoV-2 positive patients and reported that, A group individuals were more susceptible COVID-19 infection while blood group O had least vulnerability. [15]

Fan et al studied on 105 COVID-19 infected patients also reported the same that individual with A blood type, were more susceptible to COVID-19. [11]

Zhao et al studied 2173 COVID-19 positive patient and found similar results, individuals having A blood group were more prone while individual with blood group O were least prone. [9]

Solmaz and Arac researched and found a similar result of association of A blood group facing an increased risk while O blood group with low risk. Solmaz and Araç also found that in AB blood group COVID positive patients there was a significant increase in risk of infection. Our study results also showed AB blood group with increase vulnerability to COVID -19. [16]

As Indian subcontinent and Indian population is concerned a study conducted in Pakistan with 1953 patients

reported B blood group as the prevalent type (35.9%) with and increase susceptibility for COVID-19 infection. "(OR: 1.195 (95% CI: 1.04-1.36) P=0.009)".

Study from Bangladesh on 381 COVID-19 infected patients reported, A blood group to be most susceptible.[17]

Study among Indian population by Rashmi et al reported that blood group A, B & Rhesus positive were more susceptible to COVID-19 infection, whereas blood group O, AB & Rhesus negative were at a lower chance of infected with COVID-19.[18]

In our study result blood type AB & A were more susceptible while B & O where least vulnerable. Rh positive were more susceptible than Rh negative.

COVID-19 patients admitted in ICU when compared to non-ICU patients, for studying the association of blood groups and severity of disease. Our result showed no statistically significant association between severity of COVID-19 patient and ABO & Rh blood type.

Our study results collaborate with study of Almadhi et al. Almadhi et al. also found no such association in relation to blood groups and severity of COVID -19.[19] Our results also collaborate with study of Jeannette et al.[20]

Study by Uzma et al reported A & O blood groups having the majority of severe cases.[17]

While Rashmi et al on study of with Indian population reported blood group B & A to have more severe cases.[18]

Our study though gives contrasting reports. In our study blood group AB have the most severe cases reported.

In regards to mortality of COVID-19 patient Muniz – Diaz et al reported A blood group having high risk of mortality as compared to non-A blood groups, whereas O blood group having significantly low risk of mortality.[21]

Our study result contrast with the study of Muniz – Diaz, as our study result reported that ABO & Rhesus blood groups are not associated with mortality of patient infected with COVID-19.

Our study result is also in tune with study result of Solmaz and Arac. Their study also reported that classical ABO blood group have no association with mortality of COVID positive patients.[22]

6. Conclusion

Our study results did not report any statistically significant association between the classical ABO and Rhesus blood group and susceptibility to COVID-19 infection.

Our study result also shows no statistically significant association of ABO and Rhesus blood group with severity or mortality in COVID-19 infected patients.

Though our study result shows COVID-19 positive cases are more in blood group AB type and less in blood group O type.

More positive cases were also reported in Rh positive individual then Rh-negative individual.

Our study results also shown AB blood group to be more prone to ICU admission after being infected with COVID-19 that is severity is more in AB blood group.

Since AB blood group individuals were reported more in number in COVID positive and also in severity they need to take extra precaution and preventive measure should be taken and the treated immediately with no time loss and treatment progress should be monitored cautiously.

7. Limitations

This study was a single-center and hence had its limitation of limited sample size.

8. Source of Funding

No funding received.

9. Conflict of Interest

Nil.

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