
Association Between ABO-RHD Blood Groups and COVID-19: A Preliminary Study of 76 Cases

Adou Adjoumanvoule Honore^{1,*}, Siransy Kouabla Liliane¹, Memel Lasme Roselle Charline², Yeboah Oppong Richard¹, Goran-Kouacou Amah Patricia¹, Kone Djakaridja³, Kadiane N'Dri Juliette³, Assi Aya Ursule Aniela¹, Gnemagnon Mahi Eric Constant⁴, Ouattara Awa⁴, Oura Brou Doris¹, Moussa Sali¹, Koya Hebert Gautier², Seri Yida Jocelyne¹, Aba Yapo Thomas³, Krah Ouffoue³

¹Immunology-Allergology Department, Training Hospital of Cocody, Abidjan, Ivory Coast

²Immunology Department, Training Hospital of Bouake, Ivory Coast

³Infectious and Tropical Diseases Department, Training Hospital, Bouake, Ivory Coast

⁴Hematology-Biology Department, Training Hospital, Bouake, Ivory Coast

Email address:

adouh3@gmail.com (Adou Adjoumanvoule Honore)

*Corresponding author

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Abstract: *Introduction:* Blood types are most often incriminated in susceptibility to COVID-19. Blood group O subjects are reportedly less susceptible to COVID-19. However, these reports are mainly from countries with high infection rates. The overall objective of this study was to investigate the association between the risk of COVID-19 infection, its severity, and ABO-RHD blood groups at the Training Hospitals of Bouake and Cocody (Ivory Coast). *Material and methods:* This was a prospective study that lasted four months. All patients with COVID-19 at the time of the study and followed at the Training Hospitals of Bouake and Cocody, hospitalized in the COVID-19 centers or in home confinement, were included. T lymphocyte subpopulations were counted on the BD FACS Calibur flow cytometer after labeling. ABO and RHD blood typing was performed in all patients. *Results:* Of the 76 patients collected, 78.9% were homebound, 18.4% in hospital and 2.6% in the ICU. The mean age was 41.92 ± 15.13 years with a male predominance. The majority of hospitalized patients were significantly of blood group A ($p=0.020$). CD4 and CD8 T lymphopenia were significantly more frequent in patients with blood group A than in those with blood groups B, AB and O. *Conclusion:* The impact of blood group on the severity of the disease would exist. Our study showed that blood group A subjects were more likely to have COVID-19. In addition, a statistically significant association between blood type A and CD4 and CD8 T lymphopenia was found. These results should be confirmed by studies based on larger patient samples.

Keywords: Lymphopenia, CD4, CD8, COVID-19, ABO-RHD Blood Groups

1. Introduction

COVID-19 is a severe acute respiratory syndrome caused by SARS Cov-2. It most often has a mild course, but can rapidly progress to severe and sometimes fatal forms. Studies

have linked the severity of COVID-19 to the severity of T-cell lymphopenia (T CD4 and T CD8) during the course of the disease [1-4]. Indeed, CD4 and CD8 T lymphocytes, which

play a fundamental role in the adaptive immune system, are cells that generally show both quantitative and qualitative abnormalities during viral infections. In the case of COVID-19, significant differences in CD4 and CD8 T lymphocytes were observed when comparing mild and severe forms, with a significant decrease in severe forms [5, 6]. Other authors have investigated the relationship between the blood type of individuals and the risk of contracting COVID-19. There is growing evidence that ABO blood type may play a role in the immunopathogenesis of this condition. Individuals with group O blood are less likely to be positive [7] compared to those with group A blood, who are more susceptible to COVID-19 [7, 8]. However, these results remain controversial [9]. In sub-Saharan Africa, COVID-19 would be less severe than in Western countries [10]. This observation leads us to wonder whether T lymphopenia could be found in our contexts? If so, was it more important in severe forms than in mild and moderate forms? What was the impact of blood groups on COVID-19? Could the severity of T-cell lymphopenia in COVID-19 be related to blood type? The overall aim of this study was to investigate an association between COVID-19 risk, severity and ABO-RHD blood types.

2. Methodology

This was a prospective study that lasted four months. Recruitment of cases took place at the COVID-19 centers of the Training Hospital of Bouaké and the Training Hospital of Cocody (Abidjan) over a period of 6 weeks. All patients with COVID-19 at the time of the study were included. These patients were hospitalized at the COVID-19 center or in home confinement. They had agreed to participate in the study with written consent. Patients with mild COVID-19 were considered to be homebound, patients with moderate COVID-19 were hospitalized, and patients with severe COVID-19 were considered to be in intensive care. T lymphocyte subpopulation counts and ABO and RHD blood groups were performed in the Immunology-Hematology laboratories of the different University Hospital Centers. The BD FACS Calibur flow cytometer was used to count CD4 and CD8 T lymphocytes, after marking the lymphocytes with fluorochromes coupled to monoclonal antibodies specific to the markers of interest (TriTESTM CD4-FITC / CD8-PE / CD3-PerCP). The normal values for the interpretation of CD4 and T CD8 T lymphocytes were respectively between 500 and 1200 cells/mm³ and between 200 and 800 cells/mm³ of blood [10]. Severe, moderate and mild CD4 and CD8 T lymphopenia were defined as follows:

- CD4 T lymphopenia
 - 1) Severe < 150
 - 2) Moderate [150 to 350[.
 - 3) Mild [350 to 500[.
- CD8 T lymphopenia
 - 1) Severe < 50
 - 2) Moderate [50 to 150[.
 - 3) Mild [150 to 200[.

ABO and RHD blood groupings were performed by the opaline plate agglutination technique with monoclonal antibodies. The presence or absence of agglutination confirmed the blood group.

Data analysis was performed with SPSS 22 software. A threshold of 0.05% was considered significant. Pearson correlation was used to compare two quantitative variables. The chi-square test, or alternatively Fisher's exact test, was used for comparisons of two variables.

3. Results

Of the 76 patients collected, 78.9% were homebound, 18.4% were hospitalized, and 2.6% were in intensive care.

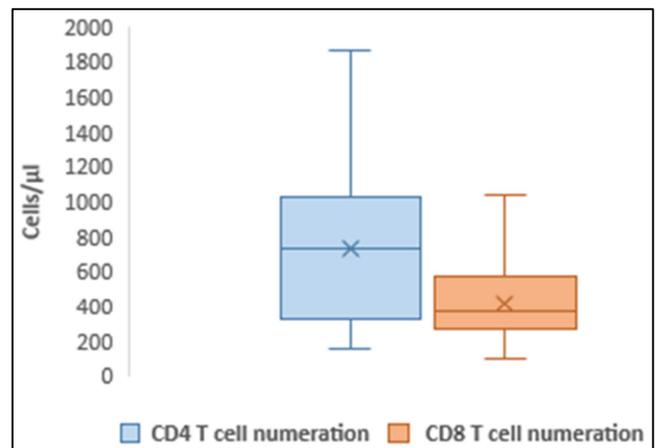
3.1. Sociodemographic Characteristics and ABO Phenotypes of the Study Population

Table 1. Distribution of patients by gender, age groups and ABO blood types.

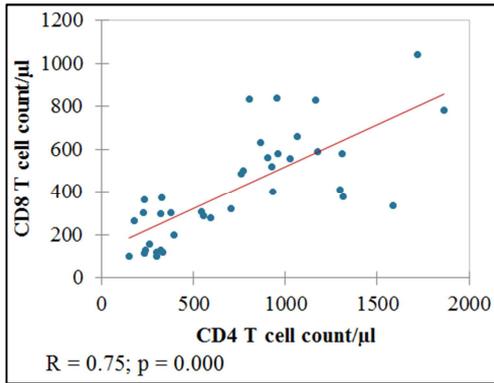
	N = 76	%
Gender distribution		
Male	44	57.9
Female	32	42.1
Sex-ratio = 1,37		
Age distribution (year)		
< 18	2	2.5
18 - 25	6	7.9
26 - 35	20	26.3
36 - 45	22	28.9
46 - 55	16	21.1
> 55	10	13.2
Mean age = 41.92 +/- 15.13 years [1 - 80 years]		
Distribution of patients by ABO blood type		
Group A	20	26.3
Group B	24	31.6
Group AB	2	2.6
Group O	30	39.5

The male sex predominated with a sex ratio of 1.37. The mean age was 41.92 ± 15.13 years with extremes of 1 - 80 years. We observed a predominance of phenotype O (39.5%). All subjects were RHD positive.

3.2. T Cell Count



(a)



(b)

Figure 1. (a) T cell distribution; (b) CD4 and CD8 T lymphocytes correlation.

CD4 and CD8 T Lymphocytes were significantly correlated.

Table 2. Distribution of patients according to CD4 and CD8 T lymphopenia.

		N = 76		%
CD4 T lymphopenia	Present	Mild	4	5.3
		Moderate	24	31.6
		Severe	2	2.6
Absent		46	60.5	
CD8 T lymphopenia	Present	Mild	2	2.6
		Moderate	16	21.1
		Severe	0	0.0
Absent		76.3		

CD4 T lymphopenia was observed in 39.5% of cases with a predominance of moderate forms. Similarly, CD8 T lymphopenia was observed in 23.7% of cases with a predominance of moderate forms.

3.3. Comparative Study

Table 3. Distribution of CD4 T lymphopenia severity according to containment mode.

CD4 T lymphopenia	Mode of confinement			p
	Home	Hospitalization		
Mild	4	0		0.020
Moderate	12	12		0.188
Severe	0	2		0.001
TOTAL	16	14		

CD4 T lymphopenia was discretely more severe in hospitalized patients than at home. The observed differences were significant. We found a greater moderate CD8 T lymphopenia in hospitalized patients. The observed differences were not significant. The majority of hospitalized patients were blood type A compared to homebound patients who are primarily blood type O.

Severity of CD8 T lymphopenia and mode of confinement.

Table 4. Distribution of the severity of CD8 T lymphopenia according to the mode of confinement.

T CD8 lymphopenia	Mode of confinement			p
	Home	Hospitalization		
Mild	2	0		0.183
Moderate	6	10		0.183
TOTAL	8	10		

We found a greater moderate CD8 T lymphopenia in hospitalized patients. The observed differences were not significant.

ABO blood types and CD4 T-cell lymphopenia.

Table 5. Distribution of ABO blood types according to containment mode.

Blood types	Mode of confinement			p
	Home	Hospitalization	Intensive care	
O	30	0	0	0.000
B	16	6	2	0.330
A	12	8	0	0.020
AB	2	0	0	1.000
TOTAL	60	14	2	

Table 6. Distribution of blood types according to CD4 T lymphopenia.

Blood group ABO	CD4 T lymphopenia		p
	Absent	Present	
A	6	14	0.003
B	18	6	0.129
AB	2	0	0.516
O	20	10	0.473
TOTAL	46	30	

CD4 T lymphopenia was significantly more common in patients with blood type A.

Table 7. Distribution of blood types according to the severity of CD4 T lymphopenia.

Blood group ABO	CD4 T lymphopenia			p
	Mild	Moderate	Severe	
A	2	10	2	0.426
B	0	6	0	0.714
O	2	8	0	0.630
TOTAL	4	24	2	

Severe CD4 T lymphopenia was only in group A subjects. However, the differences were not significant.

ABO blood types and CD8 T-cell lymphopenia.

Table 8. Distribution of blood types according to CD8 T lymphopenia.

Blood group ABO	CD8 T-cell lymphopenia		p
	Absent	Present	
A	10	10	0.004
B	20	4	0.396
AB	2	0	1.000
O	26	4	0.104
TOTAL	58	18	

CD8 T lymphopenia was significantly more common in blood group A patients.

Table 9. Distribution of blood types according to the severity of CD8 T lymphopenia.

Blood group ABO	CD8 T-cell lymphopenia		p
	Mild	Moderate	
A	2	8	0.477
B	0	4	1.000
O	0	4	1.000
TOTAL	2	16	

Moderate CD8 T lymphopenia was predominantly found in group A subjects. However, the differences were not significant.

4. Discussion

In our study population, 78.9% were homebound, 18.4% were hospitalized and 2.6% were in the ICU. Many studies in Western countries have shown a high frequency of hospitalization of patients with COVID-19 [11, 12]. This has been the opposite of the observations of some surveys in Africa. Donamou *et al* reported in their study, in the Donka hospital (Guinea), a low prevalence of admission to hospital, especially in intensive care, close to our results, of 2.3% [13]. These results confirmed the assertion that COVID-19 affects less the African continent [14]. This condition could occur at any age [15]. This was also the case in our study population in which the extreme ages and the mean age were respectively 1 - 80 years and 41.92 ± 15.13 years: The male sex predominated with a sex ratio of 1.37. Several previous studies on the epidemiology of COVID-19 patients in various countries reported that males were the most affected [13, 16, 17]. These different results were in accordance with those of the literature: "men would have an increased susceptibility to COVID-19 than women who have a more robust cellular immune response" [18].

The lymphocyte count revealed CD4 lymphopenia in 39.5% of cases, with a predominance of moderate forms. Similarly, we observed CD8 T lymphopenia in 23.7% of cases with predominantly moderate forms. T lymphopenia would thus be a reality in COVID-19 and like our study, several other studies mentioned it. The CD4 T lymphopenia in our case was discreetly more severe in hospitalized patients than at home. The differences observed were significant. Moderate CD8 T lymphopenia was greater in hospitalized patients. However, the observed differences were not significant. The majority of hospitalized patients were blood type A compared with homebound patients who were predominantly blood type O. CD4 T lymphopenia was more frequent in patients with blood type A and was severe only in subjects with this phenotype. However, the differences were not significant. In a similar study, Dimassi *et al.* found a statistically significant difference in the rate of resuscitation in blood group A patients [19]. Other studies carried out in Tunisia, France and China have also reported the severity of COVID-19 in patients with blood group A compared to those with blood group O [19-22]. All these results would justify that the subjects of blood group A would be more likely to make the severe forms of this affection contrary to the other groups.

5. Conclusion

CD4 and CD8 T lymphopenia would be a reality during COVID-19. In our study population, hospitalized patients had a CD4 and CD8 T lymphopenia slightly more severe than those confined at home and they were mostly of the A phenotype. The subjects of blood group A could then make the severe forms of this affection contrary to the subjects of the other ABO blood groups. On the other hand, our study was not able to objectivate a relation between the RH blood group and the severity of COVID-19 because all the subjects were RHD positive.

References

- [1] Abdelmalek R. COVID-19, chroniques d'une pandémie annoncée COVID-19, chronicles of a forecasted pandemic.: 4.
- [2] Qin C, Zhou L, Hu Z, Zhang S, Yang S, Tao Y, *et al.* Dysregulation of Immune Response in Patients With Coronavirus 2019 (COVID-19) in Wuhan, China. *Clin Infect Dis Off Publ Infect Dis Soc Am.* 28 juill 2020; 71 (15): 762-8.
- [3] Zhou X, Ye Q. Cellular Immune Response to COVID-19 and Potential Immune Modulators. *Front Immunol [Internet].* 2021 [cité 20 janv 2022]; 12. Disponible sur: <https://www.frontiersin.org/article/10.3389/fimmu.2021.646333>
- [4] Planté-Bordeneuve T, Froidure A, Pilette C. Immunité et COVID-19 : état des lieux, vers une médecine de précision ? : 7.
- [5] Zhao Q, Meng M, Kumar R, Wu Y, Huang J, Deng Y, *et al.* Lymphopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: A systemic review and meta-analysis. *Int J Infect Dis.* juill 2020; 96: 131-5.
- [6] Huang W, Berube J, McNamara M, Saksena S, Hartman M, Arshad T, *et al.* Lymphocyte Subset Counts in COVID-19 Patients: A Meta-Analysis. *Cytom Part J Int Soc Anal Cytol.* août 2020; 97 (8): 772-6.
- [7] Goel R, Bloch EM, Pirenne F, Al-Riyami AZ, Crowe E, Dau L, *et al.* ABO blood group and COVID-19: a review on behalf of the ISBT COVID-19 Working Group. *Vox Sang.* 2021; 116 (8): 849-61.
- [8] Bourhanbour AD, Bakkouri JE. CONNAISSANCES ACTUELLES DE L'IMMUNOPATHOLOGIE DU COVID-19. *Rev Marocaine Santé Publique [Internet].* 18 mai 2020 [cité 20 janv 2022]; 7 (10). Disponible sur: <https://revues.imist.ma/index.php/RMSP/article/view/20927>
- [9] Liu N, Zhang T, Ma L, Zhang H, Wang H, Wei W, *et al.* The impact of ABO blood group on COVID-19 infection risk and mortality: A systematic review and meta-analysis. *Blood Rev.* juill 2021; 48: 100785.
- [10] Hardy ÉJL, Flori P. Spécificités épidémiologiques de la COVID-19 en Afrique: préoccupation de santé publique actuelle ou future ? *Ann Pharm Fr.* 1 mars 2021; 79 (2): 216-26.
- [11] Dosi R, Jain G, Mehta A. Clinical Characteristics, Comorbidities, and Outcome among 365 Patients of Coronavirus Disease 2019 at a Tertiary Care Centre in Central India. *J Assoc Physicians India.* 1 sept 2020; 68 (9): 20-3.
- [12] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, *et al.* Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet Lond Engl.* 15 févr 2020; 395 (10223): 497-506.
- [13] Donamou J, Bangoura A, Camara LM, Camara D, Traoré DA, Abékan RJM, *et al.* Caractéristiques épidémiologiques et cliniques des patients COVID-19 admis en réanimation à l'hôpital Donka de Conakry, Guinée: étude descriptive des 140 premiers cas hospitalisés. *Anesth Réanimation.* 1 mars 2021; 7 (2): 102-9.
- [14] Eboko F, Schlimmer S. COVID-19: l'Afrique face à une crise mondiale. *Polit Étrangère.* 2020; Hiver (4): 123-34.

- [15] COVID-19: quelles classes d'âge portent la reprise épidémique? [Internet]. BFMTV. [cité 5 mars 2022]. Disponible sur: https://www.bfmtv.com/sante/COVID-19-quelles-classes-d-age-portent-la-reprise-epidemie_AV-202111120148.html
- [16] Masson E. Études préliminaires : caractéristiques épidémiologiques, cliniques et radiologiques des patients atteints de pneumonie à SARS-CoV2 au service de pneumo-physiologie du CHU Treichville [Internet]. EM-Consulte. [cité 19 janv 2022]. Disponible sur: <https://www.em-consulte.com/article/1419490/etudes-preliminaires-caracteristiques-epidemiolog>
- [17] Moueden MA, Benlaldj D, Messaoudi R, Seghier F. Profil hématologique des patients atteints de COVID 19 au niveau du CHU d'Oran en Algérie. *Algerian J Health Sci.* 30 mars 2021; 3 (2): 22-9.
- [18] COVID-19: le système immunitaire des femmes est-il plus robuste que celui des hommes? BBC News Afrique [Internet]. [cité 19 janv 2022]; Disponible sur: <https://www.bbc.com/afrique/monde-54526559>
- [19] Dimassi I, Mahjoub S, Cherni R, Baccouche H, Chakroun A, Ben Romdhane N. Groupe sanguin ABO et sévérité de la COVID-19: étude monocentrique. *Transfus Clin Biol.* 1 nov 2021; 28 (4, Supplement): S115-6.
- [20] Kibler M, Dietrich L, Kanso M, Carmona A, Marchandot B, Matsushita K, et al. Risk and Severity of COVID-19 and ABO Blood Group in Transcatheter Aortic Valve Patients. *J Clin Med.* 22 nov 2020; 9 (11): 3769.
- [21] Li J, Wang X, Chen J, Cai Y, Deng A, Yang M. Association between ABO blood groups and risk of SARS-CoV-2 pneumonia. *Br J Haematol.* 26 mai 2020; 10.1111/bjh.16797.
- [22] Ray JG, Schull MJ, Vermeulen MJ, Park AL. Association Between ABO and Rh Blood Groups and SARS-CoV-2 Infection or Severe COVID-19 Illness : A Population-Based Cohort Study. *Ann Intern Med.* mars 2021; 174 (3): 308-15.