Scientific
Research
Publishing

Blood Count Abnormalities Associated with Death in Patients Infected with SARS-COV-2 at the Ziguinchor Epidemic Treatment Center (ETC)

Coly Mame Ngoné[1,2]*, Diallo Kalilou[3,4], Sarr Habibou[1,2], Diop Abdoulaye[1,4], Manga Noel Magloire[2,3], Diatta Alassane[1,2]

[1]Medical Analysis Laboratory, The Ziguinchor Peace Hospital, Ziguinchor, Senegal
[2]Health Sciences Training and Research Unit, The Assane Seck University of Ziguinchor, Ziguinchor, Senegal
[3]Infectious Diseases Department, The Ziguinchor Peace Hospital/Ziguinchor Epidemic Treatment Center, Ziguinchor, Senegal
[4]Medical Analysis Laboratory, The Ziguinchor Regional Hospital, Ziguinchor, Senegal
Email: *m.coly@univ-zig.sn

Abstract

Introduction: SARS-COV-2 infection is a real public health challenge for the World Health Organization and for our country. It is responsible for numerous hematological abnormalities in infected patients. **Objectives:** To describe the haemogram abnormalities in patients infected with SARS-COV-2 and to determine which ones are associated with death. **Material and Method:** We conducted a retrospective, descriptive, analytical, cross-sectional study from March 2020 to September 2021. The study included all patients hospitalized with RT-PCR-confirmed COVID-19 who performed a blood count. We evaluated the blood count profile, the pathologies found and the associated blood count abnormalities. **Results:** A total of 263 patients were included. The mean age of the patients was 63.77 years (range 12 - 90 years). The male sex represented 54.75% (n = 144) while the female sex was 45.25% (n = 119) (sex ratio = 1.21). The most common pathologies were: diabetes: 30.03% (n = 79), high blood pressure: 41.04% (n = 108), and Chronic kidney disease: 7.98 (n = 21). The abnormalities of the haemogram found were essential: anaemia 28.13% (n = 121), hyperleukocytosis with neutrophilic predominance: 29.3% (126), lymphopenia: 34.41% (n = 148), thrombocytopenia: 8.16% (n = 35). The search for hematological factors associated with death in patients showed a significant difference between hyperleukocytosis (p = 0.000) and lymphopenia (p = 0.0001). **Conclusion:** SARS-COV-2 disease was a mortality factor when associated with lymphopenia and hyperleukocytosis in our series.

1. Introduction

Since December 2019, a SARS-COV-2 pandemic still called COVID-19 [1] has been raging in the world. This pandemic has spread in less than two months across the globe forcing the World Health Organization to develop recommendations in the direction of restricting human-to-human interactions [1] [2] [3]. These measures were aimed at limiting the spread of the virus and its definitive eradication [1]. The scientific world has been looking for epidemiological, clinical, biological and therapeutic factors associated with susceptibility to this disease and its complications [4] [5]. Among the studies performed, several have concluded that there is a higher risk of death from COVID-19 when the patient is elderly or has other comorbidities [6] [7] [8]. Other studies have shown that the virus, although having a tropism for angiotensin II receptors, in its pathophysiology had hematological repercussions [9] [10] [11]. Thus, abnormalities of the hemogram and hemostasis have been described in patients with COVID-19 [12] [13]. In Ziguinchor, there is an epidemic treatment center (ETC) whose role is the management of cases diagnosed in our region. An initial study was conducted by Diallo K *et al.* [14] in our region. It revealed the epidemiological, clinical, therapeutic and prognostic characteristics of patients with COVID-19 in Ziguinchor. In a second study, we examined the blood count abnormalities associated with death in patients with COVID-19 admitted to the CTE of Ziguinchor.

2. Methods

Type, setting, patients, place and study period:

In the period of COVID-19 pandemic disease, there was an epidemic treatment center (ETC) in our area in Ziguinchor. We conducted a cross-sectional, descriptive, and analytical study over an 18-month period (March 26, 2020, to September 30, 2021). It included all patients infected with COVID-19 diagnosed by RT-PCR and hospitalized in the ETC.

Criteria of inclusion:

All the patients hospitalized and who had a complete blood count test in the beginning of their admission where included in the study.

Criteria of non-inclusion:

All the patients who did not have a complete blood count test in the beginning of their admission were excluded

Data collection and analysis:

All patients with a blood count at entry were included in our study. We collected 263 records. The parameters included were age, sex, comorbidities, blood count abnormalities, and death rate. All data were entered on EPI data stat ver-

sion 11.3. We used the chi-square test to establish the correlations between the occurrence of death and the blood count abnormalities found.

We considered the following parameters as blood count abnormalities in adults:

- Anemia: a hemoglobin level below 12 g/dl in women and 13 g/dl in men;
- Polyglobulia: a hemoglobin level above 16 g/dl;
- Thrombocytosis: a platelet count of less than 150 Giga/L;
- Thrombocytosis: a platelet count greater than 450 Giga /L;
- Hyperleukocytosis: a leukocyte count greater than 10,000/mm³;
- Neutrophilia: a neutrophil count greater than 7500/mm³;
- Neutropenia: a neutrophil count below 1500/mm³;
- Lymphocytosis: a lymphocyte count greater than 4000/mm³;
- Lymphopenia: a lymphocyte count below 1500/mm³.

3. Results

Sociodemographic profiles of patients:

The total number of patients was two hundred and sixty-three (263). The mean age was 63.77 years (range 12 - 90 years). The male sex represented 54.75% (n = 144) while the female sex was 45, 25% (n = 119) which makes a sex ratio = 1.21. The age range of 61 - 75 was predominant (42.58%).

Clinical profiles:

The most common pathologies were: Diabetes: 30.03% (n = 79), high blood pressure: 41.04% (n = 108), tuberculosis: 3.80% (n = 10), Chronic kidney disease: 7.98 (n = 21).

The most common symptoms the patients presented were dyspnea (82.82%), fever (67.16%) and cough (64.24%). The proportion of severe cases was around 56.38%.

Death occurred in 37.79% of patients (n = 99), while 59.92% (n = 158) were declared cured and discharged. Relapse occurred in 2.29% (n = 6).

Blood count abnormalities:

For a total number of 263 patients, the blood count abnormalities found were mainly:

- anemia occurring in 121 patients;
- hyperleukocytosis with a predominance of neutrophils in 126;
- lymphopenia in 148 patients;
- Thrombocytopenia in 35 patients.

One hundred and sixty-seven (167) patients had at least two abnormalities of the hemogram.

Among the ninety-nine (99) patients who died, we noted a total of 290 blood count abnormalities.

We noted a significant difference for lymphopenia and hyperleukocytosis.

4. Discussion

The occurrence of the COVID-19 pandemic has led to numerous studies that

have resulted in a better understanding of the epidemiology, clinical and biological signs and therapeutic modalities. This work has been carried out on various populations with individual or collective intrinsic characteristics [4] [5] [8]. This updated knowledge has allowed us to discuss our results and to compare them with results from elsewhere. In Ziguinchor, the first study was conducted at the epidemic treatment center (CTE) by Diallo K *et al.* [14]. It identified the epidemiological, clinical and biological profiles as well as the criteria for severity, prognosis and evolution of hospitalized patients. The present study, conducted in the same ETC, focused on the haemogram abnormalities associated with the death of patients. It gave the following results.

Socio-demographic profiles of patients:

In this study, we noted a male predominance and the average age was 60 ± 14 years [12 - 93 years] (Table 1). However, the majority of people were aged at least 60 (64.63%). These demographic aspects were found in several studies in Africa [15] [16] [17]. Other studies in China and the USA have found similar results [5] [18] [19] [20]. In all these studies, infected patients were relatively old. This could be explained by the vulnerability of the elderly to the disease, probably due to the decline of their immune defenses. The male sex represented 54.75% (n = 144) while the female sex was 45.25% (n = 119) which makes a sex ratio = 1.21 (The study by Diallo K *et al.* [14] showed a mean age of 45 ± 21 years of which 56.49% were male. The male predominance could be linked to the risky behavior of men who are more inclined to develop certain comorbidities or to become infected. Several studies carried out in different countries have shown that ACE2 would play a decisive role in the higher vulnerability of men, due to higher blood concentrations of ACE2. Certain organs would play the role of "containers" for the virus: the lungs, the digestive system, the kidneys or the testicles.

Clinical profiles:

In this study, the most common symptoms on admission were: dyspnea (82.82%), fever (67.16%) and cough (64.24%) (Table 2). Our results were similar to those of Wu *et al.* Guan *et al.* and Zhou *et al.* who had found cardinal signs occurring in the first days of infection: fever above 37.5˚C (88.7% - 4%), cough (67.8% - 81.1%), sputum (23% - 41.3%) and dyspnea (18.7% - 39.8%) [20] [21] [22].

Table 1. Age range of the patients.

Age range (year)	Frequency	Pourcentage (%)
12 - 30	9	3.42
31 - 45	20	7.60
46 - 60	64	24.33
61 - 75	112	42.58
>75	58	22.05
Total	263	100.00

Table 2. Clinical profiles of the patients.

Comorbidities	Frequency	Pourcentage (%)
High blood pressure	108	41.04
Diabetes	79	30.03
Chronic kidney disease	21	7.98
Stroke	18	6.84
Obesity	17	6.46
HIV	14	5.32
Cardiopathy	13	4.94
Asthma	11	4.18
Tuberculosis	10	3.80

Symptoms	Frequency	Pourcentage (%)
Dyspnea	217	82.82
Fever	176	67.16
Cough	169	64.24
Chest pain	89	34.09
Confusion	57	21.84
Polyarthralgias	48	18.28
Coma	44	16.92
Vomiting	27	10.19
Diarrhoea	22	8.33
Nasal discharge	19	7.20
Sore throat	4	1.52

Clinical forms	Frequency (n)	Percentage (%)
Severe forms	148	56.38
Simple forms	104	39.72
Asymptomatic forms	11	3.90

High blood pressure was the most frequent comorbidity (41.04%), followed by diabetes (30.03) (Table 3) This trend was similar to data reported by Zhou *et al.* [23] in China and by Goyal *et al.* [24] in the USA. The proportion of severe cases was around 56.38%. This result was close to the one found in the study [25]. Death occurred in 37.79% of patients (n = 99). This relatively high death rate could be explained by the comorbidities described in the literature. A meta-analysis performed by, Osman.M *et al.* [6] gave the following conclusions: COVID-19-related mortality factors identified in published prognostic studies were age, male gender, presence of comorbidities especially diabetes, severe obesity, cardiovascular disease and chronic lung disease, and presence of biological abnormalities.

Blood count abnormalities associated with SARS-COV-2:

Among the biological abnormalities most commonly found in most studies of SARS-COV-2 disease are those of the blood count and hemostasis [9] [26] [27]. The aim of this first study conducted in our region was to describe the profile of blood count abnormalities in our patients hospitalized for COVID-19 and to compare them with other populations. We obtained the following abnormalities: anemia: 28.13% (n = 121), hyperleukocytosis with neutrophilic predominance: 29.3% (126), lymphopenia: 34.41% (n = 148), thrombocytopenia: 8.16% (n = 35). One hundred and sixty-seven (167) patients had at least two abnormalities of the hemogram (Table 4). Other abnormalities such as hypereosinophilia and thrombocytosis not found in our study were found in others [28] [29].

Blood count abnormalities associated with SARS-COV-2 death:

Although SARS-COV-2 disease is accompanied by blood count abnormalities, not all of them are life-threatening [10]. This finding was made after studies showed the imputability of certain types of blood count abnormalities in the occurrence of patients hospitalized for COVID-19 [27] [30]. In our study, the abnormalities associated with death were predominantly neutrophilic hyperleukocytosis ($p < 0.001$) and lymphopenia ($p = 0.0001$) (Table 4). We did not find any association with anemia or thrombocytopenia. The study by Violetis O.A *et al.* [7] showed an association between predominantly neutrophilic hyperleukocytosis, thrombocytopenia and lymphopenia with disease severity. A study by Bellan

Table 3. Clinical outcomes of the patients.

	Clinical profiles:			
	Death	Cure	Relapse	Total
Number	99	158	6	263
Percentage	37.79%	59.92%	2.29%	100%
	Comorbidities:				
	Diabetes	Hypertension	Tuberculosis	HIV	Indetermined	Total
Number	66	103	8	11	75	263
Percentage	25.19%	39.16%	3.04%	4.18%	28.43%	100%

Table 4. Blood count abnormalities associated with death.

Blood count abnormalities	Death (n = 99)		Total	p-value
	Abnormalities + death	Abnormalities without death		
Hyperleucocytosis	93	33	126	0.0001
Anemia	72	49	121	0.402
Thrombopenia	18	17	35	0.161
Lymphopenia	107	41	148	0.001
Total abnormalities	290	140	430	

M *et al.* [31] did not find an association between anemia and mortality with COVID-19, whereas it confirmed an association with lymphopenia and thrombocytopenia. All these findings lead us to understand the usefulness of the blood count in prognosis and therapeutic decisions for patients with COVID-19.

5. Limits

This study has many limitations as it is a retrospective study and therefore based on an established database. Blood count abnormalities can occur in several types of disease. In addition, several clinical data were not available because some of the caregivers were unaware of the existence of a previous comorbidity in their patient. Another limitation was the existence of a language barrier that did not facilitate the taking of history in some patients.

6. Conclusion

Our study was conducted in a context where COVID-19 is rampant in our country with an acceptable cure rate. However, it allowed us to identify the comorbidities associated with severe prognosis and mortality in our patients. We suggest that practitioners have a critical eye for blood count abnormalities that can help establish prognosis and influence management modalities.

Acknowledgements

Conflicts of Interest

We declare that we have no conflicts of interest related to this article.

References

[1] Frimousse, S. and Peretti, J.M. (2020) Organizational Changes Induced by the Covid-19 Crisis. *Questions de Management*, **3**, 105-149. https://doi.org/10.3917/qdm.203.0105

[2] Defraigne, J.C. (2020) The Geoeconomic Impact of Covid-19 on the Globalized Economy. *Outre-Terre*, **57**, 23-46. https://doi.org/10.3917/oute2.057.0023

[3] World Health Organization (WHO) (2022) Public Health Surveillance in the Context of COVID-19: Interim Guidance. 22 July 2022. https://www.who.int/publications/i/item/WHO-2019-nCoV-SurveillanceGuidance-2022.2

[4] Kaeuffer, C., Le Hyaric, C., Fabacher, T., Mootien, J., Ruch, Y., Zhu, Y.J., *et al.* (2020) Clinical Features and Risk Factors Associated with Severe Forms of COVID-19: A Prospective Multicenter Analysis of 1045 Cases. *Médecine et Maladies Infectieuses*, **50**, S27. https://doi.org/10.1016/j.medmal.2020.06.440

[5] Plaçais, L. and Richier, Q. (2020) COVID-19: Clinical, Biological and Radiological Characteristics in Adults, Pregnant Women and Children. An Update in the Midst of the Pandemic. *La Revue de Médecine Interne*, **41**, 308-318. https://doi.org/10.1016/j.revmed.2020.04.004

[6]   Osman, M., Safer, M., Hechaichi, A., Letaief, H., Dhaouadi, S., Harizi, C., *et al.* (2019) Predictive Factors of Covid-19 Mortality: Review of the Literature. https://www.onmne.tn/wp-content/uploads/2020/10/Facteurs-de-mortalite-COVID-19_HBS_8_10_2020.pdf

[7]   Violetis, O.A., Chasouraki, A.M., Giannou, A.M. and Baraboutis, I.G. (2020) COVID-19 Infection and Haematological Involvement: A Review of Epidemiology, Pathophysiology and Prognosis of Full Blood Count Findings. *SN Comprehensive Clinical Medicine*, **2**, 1089-1093. https://doi.org/10.1007/s42399-020-00380-3

[8]   Toba, N., Gupta, S., Ali, A.Y., ElSaban, M., Khamis, A.H., Ho, S.B., *et al.* (2021) COVID-19 under 19: A Meta-Analysis. *Pediatric Pulmonology*, **56**, 1332-1341. https://doi.org/10.1002/ppul.25312

[9]   Agbuduwe, C. and Basu, S. (2020) Haematological Manifestations of COVID-19: From Cytopenia to Coagulopathy. *European Journal of Haematology*, **105**, 540-546. https://doi.org/10.1111/ejh.13491

[10]   Rahman, M.A., *et al.* (2022) Hematological Abnormalities and Comorbidities Are Associated with COVID-19 Severity among Hospitalized Patients: Experience from Bangladesh. *PLOS ONE*, **16**, e0255379. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0255379

[11]   Chen, X., Yan, L., Fei, Y. and Zhang, C. (2020) Laboratory Abnormalities and Risk Factors Associated with In-Hospital Death in Patients with Severe COVID-19. *Journal of Clinical Laboratory Analysis*, **34**, e23467. https://doi.org/10.1002/jcla.23467

[12]   Daoui, M.A. (2021) Epidemiological, Clinical and Biological Profile of COVID-19 Patients Hospitalized at the Hassan II CHR in Agadir. http://wd.fmpm.uca.ma/biblio/theses/annee-htm/FT/2021/these138-21.pdf

[13]   Taj, S., Fatima, S.A., Imran, S., Lone, A. and Ahmed, Q. (2021) Role of Hematological Parameters in the Stratification of COVID-19 Disease Severity. *Annals of Medicine and Surgery*, **62**, 68-72. https://doi.org/10.1016/j.amsu.2020.12.035

[14]   Diallo, K., Thioubou, M.A., Wembulua, B.S., Kane, Y. and Coly, M.N. (2021) COVID-19: Experience of the Epidemic Treatment Center of Ziguinchor, Southern Region of Senegal. *Journal of Infectious Diseases and Epidemiology*, **7**, Article 216.

[15]   Diop, M., Ba, P.S., Moustapha, L., *et al.* (2021) Factors Associated with Severe COVID-19 in an Epidemic Treatment Center at Dakar. *Journal of Infectious Diseases and Epidemiology*, **7**, 2474-3658. https://doi.org/10.23937/2474-3658/1510203

[16]   Faye, F.A., Berthe, A., Lawson, T.A.D., *et al.* (2021) Mise en place d'un centre de traitement des épidémies (CTE) pour Covid-19 dans un service de Médecine Interne; Les leçonsap-prises. *Revue Africaine de Médecine Interne*, **8**, 32-36.

[17]   Angelo, A.C., Clodel, Y., Léopold, C., Serge, A., Ibrahim, M.C., Julien, A., *et al.* (2023) Epidemiological, Clinical, Therapeutic Features and Predictors of Death among COVID-19 Patients Hospitalized in Parakou: A Cross-Sectional Study in Northern Benin. *BMC Infectious Diseases*, **23**, Article No. 484. https://doi.org/10.1186/s12879-023-08445-z

[18]   Yang, X., *et al.* (2020) Clinical Course and Outcomes of Critically Ill Patients with SARS-CoV-2 Pneumonia in Wuhan, China: A Single-Centered, Retrospective, Observational Study. *The Lancet Respiratory Medicine*, **8**, 475-481. https://doi.org/10.1016/S2213-2600(20)30079-5

[19]   Zhou, F., *et al.* (2020) Clinical Course and Risk Factors for Mortality of Adult Inpatients with COVID-19 in Wuhan, China: A Retrospective Cohort Study. *The Lancet*, **395**, 1054-1062. https://doi.org/10.1016/S0140-6736(20)30566-3

[20]   Wu, C.M., Chen, X.Y., Cai, Y.P., *et al.* (2020) Risk Factors Associated with Acute

Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Internal Medicine*, **180**, 934-943. https://doi.org/10.1001/jamainternmed.2020.0994

[21] Guan, W., Ni, Z., Hu, Y., Liang, W., Ou, C., *et al.* (2020) Clinical Characteristics of Corona-Virus Disease 2019 in China. *The New England Journal of Medicine*, **382**, 1708-1720. https://doi.org/10.1056/NEJMoa2002032

[22] World Health Organization (2021) WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/

[23] Zhou, F., Yu, T., Du, R.H., Fan, G.H., Liu, Y., Liu, Z.B., *et al.* (2020) Clinical Course an Risk Factors for Mortality of Adult Inpatients with COVID-19 in Wuhan, China: A Retrospective Cohort Study. *The Lancet*, **3959**, 1054-1062. https://doi.org/10.1016/S0140-6736(20)30566-3

[24] Goyal, P., Choi, J.J., Pinheiro, L.C., *et al.* (2020) Clinical Characteristics of Covid-19 in New York City. *The New England Journal of Medicine*, **382**, 2372-2374. https://doi.org/10.1056/NEJMc2010419

[25] Faye, A., Ndao, A., Diagne, N., *et al.* (2022) The COVID-19 Pandemic in Senegal: Experience of an Internal Medicine Department as an Epidemic Treatment Center. *Open Journal of Internal Medicine*, **12**, 13-21. https://doi.org/10.4236/ojim.2022.121002

[26] Sun, S., Cai, X., Wang, H., He, G., Lin, Y., Lu, B., *et al.* (2020) Abnormalities of Peripheral Blood System in Patients with COVID-19 in Wenzhou, China. *Clinica Chimica Acta*, **507**, 174-180. https://doi.org/10.1016/j.cca.2020.04.024

[27] Rahman, A., Niloofa, R., Jayarajah, U., De Mel, S., Abeysuriya, V. and Seneviratne, S.L. (2021) Hema-Tological Abnormalities in COVID-19: A Narrative Review. *The American Journal of Tropical Medicine and Hygiene*, **104**, 1188-1201. https://doi.org/10.4269/ajtmh.20-1536

[28] Lucijanic, M., Krecak, I., Soric, E., Sedinic, M., Sabljic, A., Derek, L., *et al.* (2021) Thrombocytosis in COVID-19 Patients without Myeloproliferative Neoplasms Is Associated with a Better Prognosis but a Higher Rate of Venous Thromboembolism. *Blood Cancer Journal*, **11**, Article No. 189. https://doi.org/10.1038/s41408-021-00585-2

[29] Lindsley, A.W., Schwartz, J.T. and Rothenberg, M.E. (2020) Eosinophil Responses during COVID-19 Infections and Coronavirus Vaccination. *Journal of Allergy and Clinical Immunology*, **146**, 1-7. https://doi.org/10.1016/j.jaci.2020.04.021

[30] Yarali, N., Akcabelen, Y.M., Unal, Y. and Parlakay, A.N. (2021) Hematological Parameters and Morphological Abnormalities of Peripheral Blood in Children with COVID-19. *Pediatric Blood & Cancer*, **68**, e28596. https://doi.org/10.22541/au.159069193.34265275

[31] Bellan, M., Azzolina, D., Hayden, E., Gaidano, G., Pirisi, M., Acquaviva, A., *et al.* (2021) Simple Parameters from Complete Blood Count Predict In-Hospital Mortality in COVID-19. *Disease Markers*, **2021**, e8863053.