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Relationship of Complete Blood Count Indices with Severity of COVID-19

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ABSTRACT

Background: The coronavirus disease (COVID-19) is a worldwide pandemic. One of the important things that characterizes the disease is its unpredictable clinical course in which it can rapidly deteriorate from a moderate to severe or even lethal sequence. It can affect all body systems in addition to some psychological problems like suspicion, anxiety, and fear. The role of hematological parameters and their relation with the disease severity, despite extensive studies, is not clear till now. The study aimed to illustrate the relation between alterations of some hematological parameters and the severity of COVID-19 infection.

Method: This cross-sectional study was performed in Merjan Medical City, Hilla, Iraq. The period of the study continued from September 2021 to April 2023, it included 243 COVID-19 patients (122 males and 121 females). Several blood parameters were measured that involved hemoglobin level, red blood cell count, neutrophil count, lymphocyte count, platelet count, and neutrophil/lymphocyte ratio.

Results: The study included 243 patients with COVID-19, their mean age was 52.25±17.14. years. Regarding the severity, the most predominant cases were those with the severe level (144, 59.2%). Regarding the hemoglobin (Hb) level between groups, the study revealed a significant difference between critical and severe groups (p=0.02). Regarding white blood cell (WBC) count, there were significant differences between the critical group and all other groups (p value=0.03, 0.007, 0.02 respectively). In respect of platelet count, there were significant differences in platelet count between the critical patient group and the mild patient group (p value=0.04) and moderate patient groups (p values =0.03). Regarding
comparison of neutrophil/lymphocyte ratio (NLR) between critical patients and patients with mild, moderate, and severe groups, the study illustrated significant differences between all groups (p=0.00, 0.00 and 0.005 respectively).

Conclusions: This study revealed that Covid-19 had significant effects on platelet and white blood cell counts with no or slight effects on red blood cells and hemoglobin, and these effects were significantly associated with the severity of the disease.

Keywords: hematological parameters, COVID-19 virus disease, critical patients.

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INTRODUCTION

The coronavirus disease 2019 is a pandemic disease and began to spread in December 2019 and caused a great threat to human health [1]. About 459 cases of COVID-19 and 6 million deaths were confirmed in 2022 [2]. The disease causes problems in all body systems in addition to causing psychological distress like depression, fatigue, low mood, anxiety, and insomnia. It is diagnosed by viral and imaging tests. Other tests, whether hematological or radiological have advantages in determining the severity and prognosis of the disease [3,4]. One of these hematological tests is a complete blood count (CBC) which represents the most common test performed clinically in hospitalized patients because it is a rapid, low cost test that is easy to be performed, [5]. During the infection with COVID-19, many alterations in blood cells occur [6]. These changes had a close relation with the severity of the disease as found in many studies [7,8 and 9]. The reports of World Health Organization in 2022 mentioned that COVID-19 infection resulted in a 1.3% mortality rate and 86.6% of patients were treated and discharged from the hospital [10 and 11]. So the determination of the severity and progression of the infection had great practical importance by finding the factors that are related to patients' condition improvement [12]. This work conducts a cross-sectional study to determine the role of CBC tests in the management of patients with COVID-19 infection to develop a suitable strategy for the patients' recovery.

PATIENTS AND METHODS

This is a cross-sectional study that was conducted in Merjan Medical City, Hilla, Iraq, in a period from September 2021 to April 2023. Demographic and clinical data were collected from patients. The study involved 243 COVID-19 patients (122 males and 121 females). Patients were diagnosed depending on serological and radiological tests. All patients were admitted to the hospital irrespective of severity. The patients were classified according to severity into mild, moderate, severe, and critical groups according to World Health Organization (WHO) criteria for the clinical management of COVID-19 as follows: The mild cases included patients with mild clinical symptoms with no presence of pneumonia on imaging studies. The moderate cases included patients with

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clinical respiratory symptoms and fever with signs of pneumonia on imaging. The severe cases included patients with features of respiratory distress and significant progression of lung lesions on imaging within 24-48 h. Lastly, the critical cases included patients with respiratory failure and the requirement of mechanical ventilation [13]. A blood sample was taken from each case and sent to the laboratory to detect results of the blood profile. Several blood parameters were measured that involved hemoglobin level, red blood cell count, neutrophil count, lymphocyte count, platelet count, and neutrophil/lymphocyte ratio (NLR). The reference ranges were RBC: 4.5 - 6.3 × 1012/L in males and 4.2 - 5.4 × 1012/L in females; WBC: 4 - 10 × 109/L;: PLT: 140 - 400 × 109/L (10).

STATISTICAL ANALYSIS:

Statistical analysis was conducted using SPSS version 24. Continuous variables were presented as (means ± SD). A paired t-test was used in the difference comparison of continuous variables. A p-value ≤ 0.05 represented the level of statistical significance.

RESULTS:

The study involved 243 cases, with a mean age of 52.25±17.14. years. Table (1) shows the distribution of patients according to the severity. Patients with severe levels were the most predominant (144, 59.2%).

Table (1): distribution of patients according to the severity

Stage	No.	Percentage (100)
Mild	19	7.8
Moderate	64	26.5
Severe	144	59.2
Critical	16	6.5
Total	243	100

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Table (2) showed the comparison of hemoglobin (Hb) and red blood cell (RBCs) levels between critical patients and patients with mild, moderate, and severe classes, there was only a significant difference between critical and severe groups in both parameters (p=0.02 and p=0.01 respectively).

Table (2): comparison of hemoglobin (Hb) and red blood cell (RBCs) levels between critical patients and patients with mild, moderate, and severe groups

Parameter	Group	Mean	Std. Deviation	P value
Hemogobin (Hb) level (grams per deciliter)	Critical	13.33	1.67	0.6
	Mild	13.07	2.26	
	Critical	12.82	1.54	0.2
	Moderate	13.30	1.75	
	Critical	12.82	1.54	0.02
	Severe	13.87	2.22	
Red blood cells (RBCs) level (10^{12}/L)	Critical	4.73	0.58	0.09
	Mild	4.70	0.73	
	Critical	4.62	0.52	0.89
	Moderate	4.72	0.80	
	Critical	4.62	0.52	0.01
	Severe	4.95	0.83	

Regarding white blood cell (WBC) count, the study revealed significant differences between the critical group and all other groups as illustrated in table (3).

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Table (3): Comparison of white blood cells (WBC) level between the critical patients group and mild, moderate, and severe patient groups

Parameter	Groups	Mean	Std. Deviation	P value
White Blood Cells (WBC) count (WBCs per microliter)	Critical	13.87	6.96	0.03
	Mild	8.87	4.34	
	Critical	12.46	6.78	0.007
	Moderate	8.21	4.83	
	Critical	12.46	6.78	0.02
	Severe	9.58	4.71	

There were significant differences in platelet count between the critical patient groups and mild and moderate patient groups (p values =04 and 0.03, respectively), while there was no significant difference between the critical patient group and severe group (p value=0.4) as shown in table (4).

Table (4): comparison of platelet levels between critical patients and patients with mild, moderate, and severe groups

Parameter	Groups	Mean	Std. Deviation	P value
Platelets count(platelets per microliter)	Critical	270.73	111.49	0.04
	Mild	209.63	94.13	
	Critical	250.83	129.66	0.03
	Moderate	225.10	90.39	
	Critical	250.83	129.66	0.4
	Severe	220.35	81.46	

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Table (5) showed the comparison of neutrophil/lymphocyte ratio (NLR) between critical patients and patients with mild, moderate, and severe groups. There were significant differences between the critical patient group and all other patient groups' severity (p=0.00, 0.00 and 0.005 respectively).

Table (5): Comparison of neutrophil/lymphocyte ratio (NLR) between critical patients and patients with mild, moderate, and severe groups

Parameter	Group	Mean	Std. Deviation	P value
Neutrophil/lymphocyte ratio (NLR)	Critical	18.19	12.85	0.00
	Mild	6.79	7.19	
	Critical	17.02	12.83	0.00
	Moderate	6.86	5.35	
	Critical	17.02	12.83	0.005
	Severe	10.25	5.24	

In our study, the comparison of neutrophil counts between critical patients and patients with mild, moderate, and severe groups was also illustrated, and it revealed significant differences between critical and all other severity groups (p=0.01, 0.001, 0.002, respectively), as shown in table (6).

Table (6): comparison of neutrophil count level between critical patients and patients with mild, moderate, and severe groups

Parameter	Groups	Mean	Std. Deviation	P value
Neutrophil count	Critical	11.01	6.38	0.01
	Mild	8.13	4.22	
	Critical	11.01	6.38	0.001
	Moderate	6.38	3.88	
	Critical	11.01	6.38	0.002
	Severe	6.05	3.75	

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Table 7 shows the comparison of lymphocyte count between critical patients and patients with mild, moderate, and severe groups. There were significant differences between the critical patient group and the mild and moderate patient groups (p=0.04 and 0.03, respectively), while there was no significant difference between the critical patient group and the severe group (p=0.18).

Table (7): comparison of lymphocyte counts between critical patients and patients with mild, moderate, and severe groups

Parameter	Groups	Mean	Std. Deviation	P value
Lymphocyte count (10^3/µL)	Critical	39.90	4.53	0.04
	Mild	39.34	6.34	
	Critical	38.71	4.04	0.03
	Moderate	39.49	5.32	
	Critical	38.71	4.04	0.18
	Severe	41.54	6.46	

DISCUSSION

In this study on patients with variable stages of COVID-19 infection severity, we found significant differences between the critical group with several hematological parameters. The effects of COVID-19 infection on hemopoiesis were explored in many studies, and some studies revealed that the infection causes consumption in T-lymphocyte cells, resulting in lymphopenia (12). Other studies found thrombocytopenia, which is highly associated with the severity of disease. The possible explanation for this decrease in platelets is that the virus causes endothelial damage, which results in activation of platelets with formation of microthrombus in pulmonary vasculature that ultimately leads to platelet consumption and thrombocytopenia (14). Neutrophil/lymphocyte ratio (NLR) is a very important parameter that can determine the severity of cases, and in patients more than 50 years old, NRL more than 3.1 means those patients are more likely to have critical illness (15,16). Our study found an increase in NLR that was significantly

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associated with disease severity. This finding was consistent with most studies on COVID-19 like Palladino, 2021(2) and Chan AS, Routa A (2020) (17). One study by Zhang *et al.* mentioned that NLR together with IgG levels was associated with the severity of the disease better than neutrophil count alone (18). In most studies, NLR was associated with the disease progression, and the mechanism behind this was not clearly explained. (19). Jin *et al.*, 2020 illustrated that the total number of white blood cells in peripheral blood was normal or decreased at early stages of the disease, while the lymphocyte count decreased (20). The increase of NLR should take great attention because this increase means either elevation in neutrophil counts and/or lymphocyte counts decrease. Increased neutrophil counts mean that there is a bacterial infection, while decreased lymphocyte counts suggest a compromised system (21). The study found no or slight alterations in hemoglobin and erythrocyte counts, and this disagrees with a study performed by Palladino, 2021, that illustrated that the infection can interfere with hemoglobin at the erythrocyte and bone marrow level (2). One study by Zahra et al. (2022) found that changes occurred in nearly all complete blood count indices except platelet and basophils in a group of patients with moderate levels, meaning increased body immune defense in this stage of severity. In addition, this study revealed that great changes were found in CBC test, lymphocytes, and neutrophils (22).

LIMITATIONS OF THE STUDY

Other cells can be involved in future studies, like monocytes, eosinophils, basophils, and the platelet lymphocyte ratio. The sample size could be better if it were slightly more expanded, and the rapidly evolving nature of COVID-19 requires continuous research and studies to be involved with the new alterations in the disease pathogenesis.

CONCLUSION

This study revealed that Covid-19 had considerable effects on complete and differential white blood cell counts with no or slight effects on red blood cells and hemoglobin, and these effects were significantly associated with the severity of the disease.

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ETHICS APPROVAL

The authors of this study declare that their work, including the questionnaire and procedure followed the regulations of the suitable clinical research ethics and the principles of the Code of Ethics of the World Medical Association (Declaration of Helsinki, 2013), and it was approved by the Publication Ethics Committee of the College of Medicine, University of Babylon, Iraq, under the number BMS/0255/016.

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Conflict of interests.

There are non-conflicts of interest.

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