The Adaptation of Hemoglobin (Hb) and White Blood Cells (WBCs) in Severe Cases of SARS-Cov-2

Tarik M Abdul Majeed Al-Bermani[1], Hadeel Riyadh Ibrahim[2*] and Ahmed Jamal Jasim Alqaisi[2]

[1]Respiratory Department, AL-Karama Teaching Hospital, Ministry of health /Environment, Baghdad, Iraq [2]Hereditary Blood Diseases Center, AL-Karama Teaching Hospital, Ministry of health /Environment, Baghdad, Iraq
https://doi.org/10.47275/0032-745X-354

Abstract

SARS-CoV-2 cause alterations in the hematological parameters and many studies have concentrated on this area and correlated these with severity of disease. A retrospective study of severe cases of COVID-19 were reviewed. The data of hemoglobin (Hb) and white blood cells (WBCs) were accounted and documented. Patients recruited at period from March to July, 2021. Retrospectively, data extracted on the Hb level and WBC counts from Lab reports both at admission and when patients discharge. The frequencies of anemia or erythrocytopenia (Hb <12 g/dL) and leukocytosis (WBC >11×10^3/μL) was calculated in the studied population. Of 3637 SARS-COV-2 cases, 250 patients with severe conditions of COVID-19 as de ne by WHO, which were either admitted to ICU or died. Of 250, 80(32%) were entered to ICU, and the rest 170 cases (68%) who died. While the mean age of the patients was 55.46±17.49 years, patients with the severe condition were signi cantly older than those with the mild-moderate condition (mean age of 50.68 vs. 68.59; P: <0.01). The mean number of white blood cells (WBC) was 8.88±7.29 x10^9/L in all SARS-COV-2 patients, which is signi cantly higher in the severe cases compared to those with the mild-moderate disease (10.56 vs. 8.95; P: <0.01). The Hb level (<12 g/dL) was lower in the severe COVID-19 than other groups; however, it was not statistically signi cant. Increased number of WBCs and dropped Hb level during hospitalization of SARS-COV-2 patients may predict a poor outcome. We concluded that not only the mean number of WBCs was signi cantly higher in the severe cases also leukocytosis was a common nding; indicating that an increased number of WBCs may probably predict a poor outcome. Also, the level of Hb was higher in the mild-moderate group; however, it was not statistically signi cant.

Keywords: SARS-COV-2; COVID-19; Hemoglobin; White Blood Cells *_Correspondence to:_ Hadeel Riyadh Ibrahim, Hereditary Blood Diseases Center, AL-Karama Teaching Hospital, Ministry of health /Environment, Baghdad, Iraq

Introduction

The unforgotten month in the new history is December 2019 when an outbreak of COVID-19 in Wuhan, China discovered and became a big issue in the emergenic public health [1]. Yet, the disease course has many peaks of severity in most countries and the number of recovered cases is increasing [2], but the deaths number is increment gradually [3]. e respiratory system involvement was mostly seen at the majority of patients but recently many studies estimated the hyper- in ammatory nature of the COVID-19, which may a ect di erent systems in the body [4,5]. Several studies have recorded the alterations in hematological parameters as indicator of severity [6]. Nearly all studies are documenting an increased number of WBC count in severe SARS-COV-2, thus the level of Hb may be a ecting or not [7]. In evidence term, some studies have indicated the prognostic values of thrombocytopenia [8,9], neutrophilia, and lymphopenia [10-12] in SARS-CoV-2 infection, while other studies have documented no signi cant changes [13] and a few reports showed a decrease in the parameter level [14].

Here, we evaluate the alteration of Hb and WBC during severe COVID-19 infection. Also,

Table 1: Baseline features and hematologic data of the study.

		Mild - moderate cases	Severe	Total	P value
		No. (%)/ mean±SD			
COVID-19 patients		3387 (93.13)	250 (6.87)	3637	0.01
Age (years)		50.68±13.4	68.59±10.65	55.46±17.49	0.01
Gender	Male	2011 (92.5)	163 (7.49)	2174	0.09
	Female	1376 (94.04)	87 (5.96)	1463	
WBC	>11	10.56± x103	8.95± x10^3	8.88±7.29 x10^3	0.01
Hb	<12	13.19±2.5	10.49±2.33	11.24±1.34	0.06

we investigate if there is any correlation between the blood counts and severity of SARS-CoV-2.

Methods

A retrospective study of 250 severe COVID-19 cases was conducted, which approved by the AL-Karama Teaching Hospital Ethics Committee. Patients recruited at period from March to July, 2021. All COVID-19 cases were proven diagnosed by chest CT scan and PCR testing. Retrospectively, data extracted on the Hb level and WBC counts from Lab reports both at admission and when patients discharge. e frequencies of anemia or erythrocytopenia (Hb <12 g/ dL) and leukocytosis (WBC >11×10^3/μL) was calculated in the studied population. e entrance to the intensive care unit (ICU) was de ned as criteria for the severity of the COVID-19. All the statistical analyses were performed using the IBM SPSS version 24.0 (IBM Corp., NY, USA). e normally distributed variables were described as the means± standard deviation (SD). Categorical variables were summarized as frequencies (percentages). e normally distributed continuous variables were compared between mild-moderate and severe groups using the two independent sample t-test. A P value of less than 0.05 was considered to indicate a statistically signi cant di erence.

Results

Of 3637 SARS-COV-2 cases, 250 patients with severe conditions of COVID-19 as de ne by WHO, which were either admitted to ICU or died. Of 250, 80 (32%) were entered to ICU, and the rest 170 cases (68%) who died. While the mean age of the patients was 55.46±17.49 years, patients with the severe condition were signi cantly older than those with the mild-moderate condition (mean age of 50.68 vs. 68.59; P: <0.01). e mean number of white blood cells (WBC) was 8.88±7.29 x10^3/μL in all SARS-COV-2 patients, which is signi cantly higher in the severe cases compared to those with the mild-moderate disease (10.56 vs. 8.95; P: <0.01). Of particular interest, the same nding was found concerning the level of hemoglobin in these patients. e Hb level (<12 gm/dL) was lower in the severe COVID-19 than other groups; however, it was not statistically signi cant. Increased number of WBCs and dropped Hb level during hospitalization of SARS-COV-2 patients may predict a poor outcome. (Table 1)

Discussion

Coronavirus disease-2019 is a type of respiratory syndrome symptomatically spanning from healthy carriers to patients with life- threatening complications and may lead to death. Although most cases display no or mild-to-moderate clinical symptoms, some patients are admitted with a severe condition necessitating specialized management at intensive care units (ICU) [15]. us far, multiple lines of studies have focused on the identi cation and application of novel approaches to precisely estimate SARS-COV-2 outcome. e results of a recent study have demonstrated that analysis of the laboratory parameters not only provides an appropri-

ate diagnostic signi cance but the alteration of these parameters may also predict unfavorable outcomes in SARS- CoV-2 infection [16]. In this retrospective Double Centre study reviewing the results of the WBC and Hb counts of SARS-COV-2 patients (250 of whom had severe disease), we found that the number of WBC was higher in the severe COVID-19, which was signi cantly higher when compared to those with the non-severe disease. Accordingly, we found that leukocytosis is a common nding among severe SARS-COV-2 patients; indicating that an increased number of WBC may probably predict a poor outcome. In consistent, Huang et al. documented that the percentage of severe SARS-COV-2 patients who had increased WBC counts was signi cantly higher than non-severe counterparts (54% vs. 19%), further highlighting the fact that the extent of deviation from normal white blood cell counts associates with disease severity [15]. Our results were also in agreement with several studies that reported the occurrence of leukocytosis in 32% [17], 30% [11], 24% [18], 22% [19], and 21% [20,21] of infected cases. In addition, anemia or low level of Hb was noted in severe COVID-19 cases with no signi cant association. In agreement, Wang et al. reported that SARS- COV-2 cases who died of the disease displayed a higher number of WBCs during hospitalization than those who survived [12]. Al-Saadi EAKD, et al. (2021) [22], concluded that the monitoring hematological changes in patients with COVID-19 can predict patients needing additional care and stratify the risk for severe course of the disease.

More studies are required in Iraq to re ect the hematological changes in COVID-19 as compared to global data.

Conclusions

We revealed that not only the mean number of WBCs was signi cantly higher in the severe cases also leukocytosis was a common nding; indicating that an increased number of WBCs may probably predict a poor outcome. Also, the level of Hb was higher in the mild- moderate group; however, it was not statistically signi cant. Further investigations in the eld of the identi cation and application of laboratory biomarkers that can enable to rapidly and economically predict SARS-COV-2 prognosis will pave the way to better management.

References

1. Lu H, Stratton CW, Tang YW (2020) The Wuhan SARS-CoV-2-What's next for China. J Med Virol 92: 546-547. https://doi.org/10.1002/jmv.25738
2. Wu Z, McGoogan JM (2020) Characteristics of and important lessons from the coronavirus disease 2019 (SARS-COV-2) outbreak in China: summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention. JAMA 323: 1239-1242. https://doi.org/10.1001/jama.2020.2648
3. Du Y, Tu L, Zhu P, Mu M, Wang R, et al. (2020) Clinical features of 85 fatal cases of SARS-COV-2 from Wuhan. A retrospective observational study. Am J Respir Crit Care Med 201: 1372-1379. https://doi.org/10.1164/rccm.202003-0543OC
4. Yang Y, Shen C, Li J, Yuan J, Yang M, et al. (2020) Exuberant elevation of IP-10, MCP- 3 and IL-1ra during SARS-CoV-2 infection is associated with disease severity and fatal outcome. medRxiv. https://doi.org/10.1101/2020.03.02.20029975
5. Xiong Y, Liu Y, Cao L, Wang D, Guo M, et al. (2020) Transcriptomic characteristics of bronchoalveolar lavage uid and peripheral blood mononuclear cells in SARS-COV-2 patients. Emerg Microbes Infect 9: 761-770. https://doi.org/10.1080/22221751.2020.1747363
6. Lippi G, Plebani M (2020) Laboratory abnormalities in patients with COVID-2019 infection. Clin Chem Lab Med 58: 1131-1134. https://doi.org/10.1515/cclm-2020-0198
7. Lu G, Wang J (2020) Dynamic changes in routine blood parameters of a severe SARS-COV-2 case. Clin Chim Acta 508: 98-102. https://doi.org/10.1016/j.cca.2020.04.034
8. Lippi G, Plebani M, Henry BM (2020)

Thrombocytopenia is associated with severe coronavirus disease 2019 (SARS-COV-2) infections: A meta-analysis. Clin Chim Acta 506: 145-148. https://doi.org/10.1016/j.cca.2020.03.022
9. Yang X, Yang Q, Wang Y, Wu Y, Xu J, et al. (2020) Thrombocytopenia and its association with mortality in patients with COVID-19. J Thromb Haemost 18: 1469- 1472. https://doi.org/10.1111/jth.14848
10. Yuan J, Zou R, Zeng L, Kou S, Lan J, et al. (2020) The correlation between viral clearance and biochemical outcomes of 94 SARS-COV-2 infected discharged patients. In amm Res 69: 599-606.
11. Huang C, Wang Y, Li X, Ren L, Zhao J, et al. (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395: 497-506. https://doi.org/10.1016/S0140-6736(20)30183-5
12. Wang D, Hu B, Hu C, Zhu F, Liu X, et al. (2020) Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 323: 1061-1069. https://doi.org/10.1001/jama.2020.1585
13. Liu J, Li S, Liu J, Liang B, Wang X, et al. (2020) Longitudinal characteristics of lymphocyte respons- es and cytokine pro les in the peripheral blood of SARS-CoV-2 infected patients. EBioMedicine 55: 102763. https://doi.org/10.1016/j.ebiom.2020.102763
14. Sanchez-Cerrillo I, Landete P, Aldave B, Sanchez-Alonso S, Sanchez-Azofra A, et al. (2020) Differential redistribution of activated monocyte and dendritic cell subsets to the lung associates with severity of SARS-COV-2. medRxiv. https://doi.org/10.1101/ 2020.05.13.20100925
15. Xu Z, Shi L, Wang Y, Zhang J, Huang L, et al. (2020) Pathological ndings of SARS-COV-2 associated with acute respiratory distress syndrome. Lancet Respir Med 8: 420- 422. https://doi.org/10.1016/S2213-2600(20)30076-X
16. Perisetti A, Gajendran M, Mann R, Elhana S, Goyal H (2020) SARS-COV-2 extrapulmonary illness – special gastrointestinal and hepatic considerations. Dis Mon 66: 101064. https://doi.org/10.1016/j.dis
17. Shi H, Han X, Jiang N, Cao Y, Alwalid O, et al. (2020) Radiological ndings from 81 patients with SARS-COV-2 pneumonia in Wuhan, China: a descriptive study. Lancet Infect Dis 20: 425-434. https://doi.org/10.1016/S1473-3099(20)30086-4
18. Chen N, Zhou M, Dong X, Qu J, Gong F, et al. (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395: 507-513. https://doi.org/10.1016/S0140-6736(20)30211-7
19. Chen H, Guo J, Wang C, Luo F, Yu X, et al. (2020) Clinical characteristics and intrauterine vertical transmission potential of SARS-COV-2 infection in nine pregnant women: a retrospective review of medical records. Lancet 395: 809-815. https://doi.org/10.1016/S0140-6736(20)30360-3
20. Zhou F, Yu T, Du R, Fan G, Liu Y, et al. (2020) Clinical course and risk factors for mortality of adult inpatients with SARS-COV-2 in Wuhan, China: a retrospective cohort study. Lancet 395: 1054-1062. https://doi.org/10.1016/S0140-6736(20)30566-3
21. Chen L, Liu H, Liu W, Liu J, Liu K, et al. (2020) Analysis of clinical features of 29 patients with 2019 novel coronavirus pneumonia. Zhonghua Jie He He Hu Xi Za Zhi 43: E005. https://doi.org/10.3760/cma.j.issn.1001-0939.2020.0005
22. Al-Saadi EAKD, Abdulnabi MA (2021) Hematological changes associated with COVID-19 infection. J Clin Lab Anal 16: e24064. https://doi.org/10.1002/jcla.24064

RESUMEN

Dado que el SARS-CoV-2 causa alteraciones en los parámetros hematológicos, muchos estudios se han concentrado en esta área y los han correlacionado con la gravedad de la enfermedad. Se revisó en un estudio retrospectivo de casos graves de COVID-19, en el cual se contabilizaron y documentaron los datos de hemoglobina (Hb) y glóbulos blancos (WBC) de pacientes reclutados en el período de marzo a julio de 2021. Retrospectivamente, los datos extraídos fueron sobre el nivel de Hb y los recuentos de glóbulos blancos de los informes de laboratorio tanto al ingreso como cuando alta de los pacientes. Se calcularon las frecuencias de anemia o eritrocitopenia (Hb <12 g/dL) y leucocitosis (WBC >11×103/μL) en la población estudiada. De 3637 casos de SARS-COV-2, 250 pacientes con condiciones graves de COVID-19 según la definición de la OMS, ingresaron en la UCI o fallecieron, De 250, 80 (32%) ingresaron a UCI, y el resto 170 casos (68%) fallecieron. Mientras que la edad media de los pacientes fue de 55,46±17,49 años, los pacientes con la condición grave tuvieron significativamente mayor edad que aquellos con la condición leve-moderada (edad media de 50,68 frente a 68,59; P: <0,01). El número medio de glóbulos blancos (WBC) fue de 8,88±7,29 x109/L en todos los pacientes con SARS-COV-2, que es significativamente mayor en los casos graves en comparación con aquellos con enfermedad leve-moderada (10,56 frente a 8,95; P: <0,01). El nivel de Hb (<12 g/dL) fue más bajo en el COVID-19 grave que en otros grupos; sin embargo, no fue estadísticamente significativo. El aumento del número de glóbulos blancos y la disminución de la Hb durante la hospitalización de pacientes con SARS-COV-2, puede predecir un mal resultado. Llegamos a la conclusión de que no sólo el número medio de glóbulos blancos era significativamente mayor en los casos severos también la leucocitosis fue un hallazgo común; lo que indica que un mayor número de glóbulos blancos probablemente puede predecir un mal resultado. Asimismo, el nivel de La Hb fue mayor en el grupo leve-moderado; sin embargo, no fue estadísticamente significativo.

Palabras clave: SARS-COV-2; COVID-19; Hemoglobina; Células blancas de la sangre.