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RESEARCH ARTICLE

HEMATOLOGICAL CHANGES ASSOCIATED WITH COVID-19 INFECTION IN ADEN/ YEMEN

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Abstract

Chronic Hematological alterations in COVID-19 patients range from mild to severe, with common changes including lymphopenia, neutrophilia, and thrombocytopenia. The gold standard for diagnosis is the polymerase chain reaction (PCR) test, which is highly specific and sensitive for detecting SARS-CoV-2 genetic material. The study was a single isolation center retrospective analysis of 200 patients with COVID-19 confirmed cases. The hematological indicators were taken after sample blood collected from the staff of Central Public Health Laboratory to determine the changes, and compared between different grades of severity and prognosis with the hematological indicators. The data was analyzed using Statistical Package for the Social Sciences (SPSS) version 22.0. simple frequencies and percentage were used, while chi-square test used to determine the association between variables. Males consisted 73.5% in this study, while 63% of participants suffered from moderate severity. Related to the hematological changes; and comparisons made according to real-time PCR test results revealed that the Lymphocytopenia and leukocytosis presented among 47.5% and 46.5% respectively with significance association with illness severity and outcome of patients with p-value< 0.05. hematological changes in COVID-19 patients are a common and significant aspect of the disease. Lymphopenia, neutrophilia, thrombocytopenia, and increased levels of inflammatory markers are frequently observed. These hematological abnormalities are associated with disease severity, poor clinical outcomes. Blood parameters aid in COVID-19 diagnosis and prognosis, with abnormal hematological parameters providing early evidence. However, interpretation should consider limitations, sample size, and potential biases. Further research needed.

Keywords: Hematological indicators, COVID-19, Isolation center, Lymphocytopenia.

1. Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, originated in Wuhan, China, in December 2019. It quickly spread to numerous countries around the world, leading to a global health crisis. [1] Several viral infectious diseases can cause hematological changes in affected individuals. These changes can provide valuable information for monitoring the infectious process and predicting disease severity. Influenza viruses can affect the hematopoietic system and lead to various hematological manifestations. These may include leukopenia (reduced white blood cell count), lymphopenia (reduced lymphocyte count), and thrombocytopenia (reduced platelet count). Severe cases of influenza can also be associated with coagulopathy and disseminated intravascular coagulation (DIC). MERS-CoV infection has been associated with hematological changes such as lymphopenia and thrombocytopenia. These changes can be indicative of the severity of the disease and may help in monitoring patients. [2] A complete blood count (CBC) is a commonly requested and performed test in hematology investigations. It is a simple and widely available test that can be conducted in various healthcare settings, ranging from outpatient clinics to inpatient hospitals, including those with limited resources. Given the wide social presence of COVID-19 and the initial presentation of many patients to primary care physicians, family medicine care providers play a crucial role in reporting and providing initial treatment to these patients. [3]

In Yemen there is lack of knowledge about the morbidity, etiology, and risk factors of many diseases. Moreover, in Yemen's protracted crisis, an epidemic could result in increased population mortality both directly (from SARS-CoV-2 infection) and indirectly (due to reduced access to healthcare, lack of healthcare workers and/or medical supplies, and/or the socioeconomic costs of the pandemic and related control measures, including worsened food security). No exact figures on mortality are available in Yemen in addition; inadequate infrastructures, and the health system show some shortage of resources and improper planning, which are adversely reflected on the health of population. Information on hematological parameters can inform the ongoing response and provide evidence for additional resource mobilization. Additionally, various hematological abnormalities in infected individuals and these changes in blood cell counts and coagulation factors can have significant clinical implications and impact the management and prognosis of COVID-19 patients.

2. Methods

Retrospective cross-sectional study conducted in the Central National Public Health Laboratories (CNPHL) / Aden Governorate/ Yemen. The study population are positive cases of COVID-19 of both sexes admitted in the isolation center in Aden/ Yemen with age above 15 years and with completed laboratory file, while excluded those patients with age less than 15 years and or without laboratory file, with another respiratory syndrome, or those admitted twice time (duplicated data). Questionnaire was adapted according to the hematological indicators presented in the laboratory file or sheet and added the variables related to general information of patients (age, sex), variables related to the severity of illnesses. Two hundred patients who have gone to the isolation center of Al Gomhouria Teaching Hospital between June 2021 to January 2022 and who have been considered as possibly having COVID-19 were included. The recommended criteria established by the Scientific Committee of the Ministry of Health were used for the selection of possible COVID-19 patients. These criteria, consist of patients with either at least one sign or symptom of either fever or acute respiratory disease (cough and respiratory distress), or the presence of clinical features that are unexplainable by any other disease, or history of travel to another country in the previous 14 days before onset of symptoms of the patient or a relative, or close contact with a patient confirmed positive for COVID-19 by real-time PCR (RT-PCR). Patients from whom a throat swab was obtained and those who were thereafter hospitalized with an initial diagnosis of COVID-19 were studied retrospectively. The presenting complaints, epidemiological features and blood test results of patients were obtained from the patient files. Only the results of the initial RT-PCR and CBC tests were used and no further tests were performed on these patients. The results of this research were analyzed, summarized, univariate, and data distributions explored used simple descriptive statistics as mean, frequencies, and percentages, were used to describe the background characteristics and other variables of the study population. Cross tabulation used to determine the relation between variables.

3. Results

Table 1. Distribution of Sample Study by Sex and Age Group

Variables		No	%
Sex	Male	147	73.5
	Female	53	26.5
Age group/ years (55.69±4.83)	43-50	29	14.5
	51-58	124	62
	59-66	47	23.5

Note: % taken from the total of cases (200 case)

In table (1), the male patients consisted two third of participants (73.5%), while the female patients consisted only 26.5%. The mean age was 55.69± 4.83, the high rate (62%) was among patients at age 51-58 years c, followed by those at age 59-66 years with 23.5% while those at age 43-50 years consisted low percentage with 14.5%.

Table 2. Distribution of Patients by COVID-19 Severity and Prognosis

Variables		No	%
Severity	Moderate	126	63
	Mild	61	30.5
	Severe	13	6.5
Prognosis	Recovered	184	92
	Dead	16	8

Note: % taken from the total of cases (200 case)

In table (2). Regarding the severity of COVID- 19, the patients with moderate illness consisted only 63%, followed by those with mild illness with 30.5%. But those with severe illness appeared in low rate with 6.5% only. Related to prognosis, nearly all patients with COVID-19 recovered after attack, and only 8% of patients dead due to COVID.

Table 3. Distribution of Patients by White Cell parameters

Hematological results	NO	%
Leukocytosis	93	46.5
Leukopenia	21	10.5
Lymphocytopenia	95	47.5

Note: % taken from the total of cases (200 case)

In table (3), the leukocytosis presented among 46.5% of patients with COVID-19. And the Lymphocytopenia

presented among 47.5% of patients. The leukopenia presented only among 10.5% of patients.

Table 4. Distribution of COVID-19 Patients by Blood indices

Blood indices	NO	%
Microcytic hypochromic	68	34
Normocytic hypochromic	67	33.5
Thrombocytopenia	33	16.5
Thrombocytosis	48	24.0
Erythrocytosis	1	0.5

Note: % taken from the total of cases (200 case)

In table (4), the microcytic hypochromic and normocytic hypochromic presented among COVID-19 patients with 34% and 33.5% respectively. While noted that erythrocytosis presented only among 0.5% of patients.

Table 5. Association between Severity of Illness and Hematological Findings

Hematological investigations findings	Severity of Illness			Total	P-value
	Mild	Moderate	Sever		
Leukocytosis	68 (73.1)	17 (18.3)	8 (8.6)	93 (100)	0.002
Leukopenia	9 (42.9)	11 (52.4)	1 (4.7)	21 (100)	0.071
Lymphocytopenia	72 (75.9)	11 (11.5)	12 (12.6)	95(100)	0.001

Note: the 5% taken from total of row. The Qui square test considers significance when p-value<0.05

The table (5) illustrate the association between severity of illness and hematological findings. Leukocytosis and Lymphocytopenia appeared high among patients with mild severity (73.1% and 75.9% respectively), while leukopenia appeared among patients with moderate severity (52/4%). Regrading to the hematological changes the Lymphocytopenia consisted 12.6% higher than others change in severe cases. The chi square test's p-value of 0.003 indicates a significant association between hematological changes and the severity of illness of disease.

Table 6. Association between Severity of Illness and Blood indices

Blood Indices	Severity			Total	P-value
	Mild	Moderate	Sever		
Microcytic hypochromic	48 (70.6)	13 (19.1)	7 (10.3)	68 (100)	0.022
Normocytic hypochromic	36 (53.7)	27 (40.3)	4 (6)	67 (100)	0.101
Thrombocytopenia	17 (51.5)	10 (30.3)	6 (18.2)	33 (100)	0.010
Thrombocytosis	32 (66.7)	13 (27)	3 (6.3)	48 (100)	0.826
Erythrocytosis	1(100)	0 (0.0)	0 (0.0)	1 (100)	0.744

Note: the 5% taken from total of row. The Qui square test considers significance when p-value<0.05

According to the table (6) high rates blood indices among patients with mild illness, and low rates of all indices with severe illness. Related to the association the microcytic hypochromic (0.022) and Thrombocytopenia (0.010) had significance association with severity of illness with p-value <0.05.

4. Discussion

This current study was conducted on patients admitted to isolation center in Aden/ Yemen, and diagnosed as positive cases of COVID-19. The male patients consisted about tow third of sample size. Behaviorally, males may engage in riskier behaviors or have higher rates of underlying health conditions that contribute to the higher severity of COVID-19. Social factors, such as differences in healthcare-seeking behaviors or occupational exposure, may also play a role. Guan et al. [4] and Xiaomei Wu, et al [5] are two studies that have investigated the demographics of COVID-19 patients and reported a higher proportion of male patients. Another study done by study Abid et al, [6] when mentioned that male patients associated with a nearly 2-fold higher risk of severe SARS-CoV-2 infection. That being said, it is worth noting that several studies have suggested that COVID-19 affects males more severely than females, with males being more likely to experience severe symptoms and higher mortality rates. This observation has been attributed to a combination of biological, behavioral, and social factors. It is important to note that while these general trends have been observed, individual variations exist, and further research is needed to fully understand the relationship between gender and COVID-19 outcomes.

In our study, the majority of patients fell within the age range of 51-58 years. This finding aligns with another study that reported about 75% of COVID-19 cases being above 50 years of age. [7] This suggests that a significant portion of COVID-19 cases occur in individuals who are middle-aged or older. Furthermore, it is widely recognized that individuals aged 65 years and above are more susceptible to acquiring COVID-19 compared to younger adults. This observation has been supported by various studies, as indicated by the references you provided. [8,9] The increased vulnerability of older individuals to COVID-19 can be attributed to several factors. Age-related changes in the immune system, known as immunosenescence, can lead to a weakened immune response and reduced ability to fight off infections.

According to the data presented, the majority of patients in the study had mild to moderate severity of COVID-19 illness, while severe illness was observed in only a small percentage (6.5%) of patients. This finding is consistent with the results reported in several other studies, [10, 11, 12] which also observed a high proportion of mild to moderate cases and a low rate of severe or critical illness. Furthermore, another study found that nearly all patients with COVID-19 eventually recovered after being infected, with only 8% of cases resulting in death. This

finding aligns with another study that reported a high rate of improvement and discharge among patients with COVID-19, with deaths occurring in only a few cases. [13] It is important to note that the prognosis and outcomes of COVID-19 can vary depending on several factors, including age, underlying health conditions, and access to healthcare. While the majority of cases may have mild to moderate illness and a favorable prognosis, it is crucial to continue monitoring and studying the virus to better understand its long-term effects and identify effective treatment strategies.

In this study, hematological changes observed among patients with COVID-19 included a high rate of leukocytosis (increased white blood cell count), lymphopenia (reduced lymphocyte count), and microcytic hypochromic and normocytic hypochromic changes in red blood cells. Conversely, erythrocytosis (increased red blood cell count) was only observed in a small percentage (0.5%) of patients. These findings are consistent with the results reported by Xiaomei Wu et al. [5] and a study conducted by Aljebaly FS. [14] Leukocytosis refers to an increase in the number of white blood cells, which can be indicative of an inflammatory response or infection. Lymphopenia, on the other hand, refers to a decrease in the number of lymphocytes, which are critical components of the immune system. Both leukocytosis and lymphopenia have been commonly observed in patients with COVID-19 and may reflect the immune response to the viral infection., while microcytic hypochromic changes and normocytic hypochromic changes in red blood cells indicate alterations in their size and color, which can be associated with various conditions, including anemia. Anemia is a common finding in COVID-19 patients and can be caused by different mechanisms, such as inflammation, cytokine-mediated effects, or direct viral damage to the bone marrow.

In our study, hematological changes such as Lymphocytopenia (low lymphocyte count) were more prevalent among mild cases, while leukopenia (low white blood cell count) appeared more frequently in moderate cases. Among severe cases, Lymphocytopenia was particularly prominent compared to other changes. The findings in agreement with previous research [15] that has reported similar hematological changes in COVID-19 patients. Lymphocytopenia has been consistently observed as a common feature and indicator of COVID-19.

Regarding thrombocytopenia in COVID-19 patients. Thrombocytopenia, which refers to a low platelet count, has indeed been observed in COVID-19 patients and has been associated with the severity and prognosis of the disease. our study found that the rate of thrombocytopenia increased among mild cases of COVID-19 illness, and this finding was statistically significant with a p-value of 0.010. This suggests that thrombocytopenia may serve as a biomarker for identifying coagulopathy, or abnormal blood clotting, in COVID-19 patients. This in agreement with the findings reported by Waris et al. [16] and Khaled et al., [17] further supporting the association between thrombocytopenia and COVID-19 severity.

5. Conclusion

The study found that most patients with COVID-19 had moderate illnesses and recovered at high rates. Hematological changes, such as microcytic hypochromic and normocytic hypochromic, were high in over 40% of patients. Hematological changes, such as leukocytosis and Lymphocytopenia, had a significant association with illness severity. Monitoring these changes and understanding their implications can help in the early identification, risk assessment, and management of COVID-19 patients.

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مقالة بحثية

التغيرات الدموية المصاحبة لعدوى كوفيد-19 في عدن- اليمن

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المُلخّص

تتراوح التغيرات الدموية لدى مرضى كوفيد-19 من خفيفة إلى حادة، مع تغيرات شائعة تشمل قلة اللمفاويات والعدلات ونقص الصفيحات. المعيار الذهبي للتشخيص هو اختبار تفاعل البوليميراز المتسلسل (PCR)، وهو محدد وحساس للغاية للكشف عن المادة الوراثية لـSARS CoV-2. كانت الدراسة عبارة عن تحليل بأثر رجعي لمركز عزل واحد لـ 200 مريض مصابين بحالات كوفيد-19 المؤكدة. تم أخذ المؤشرات الدموية بعد جمع عينة دم من موظفي مختبر الصحة العامة المركزي لتحديد التغيرات، ومقارنتها بين درجات الشدة والتشخيص المختلفة مع المؤشرات الدموية. تم تحليل البيانات باستخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS) الإصدار 22.0. تم استخدام التكرارات والنسب المئوية البسيطة، في حين تم استخدام اختبار مربع كاي لتحديد الارتباط بين المتغيرات. غالبية المرضى في هذه الدراسة هم من الذكور، مع شدة معتدلة. المتعلقة بالتغيرات الدموية. وكشفت المقارنات التي تم إجراؤها وفقًا لنتائج اختبار PCR في الوقت الحقيقي أن قلة اللمفاويات وزيادة عدد الكريات البيضاء ظهرت في ما يقرب من نصف المرضى مع وجود ارتباط مهم مع شدة المرض ونتائج المرضى الذين لديهم قيمة $p < 0.05$. تعد التغيرات الدموية لدى مرضى كوفيد-19 جانبًا شائعًا ومهمًا للمرض. يتم ملاحظة قلة اللمفاويات، والعدلات، وقلة الصفيحات، وزيادة مستويات علامات الالتهاب في كثير من الأحيان. ترتبط هذه التشوهات الدموية بخطورة المرض ونتائج سريرية سيئة. تساعد مؤشرات الدم في تشخيص مرض كوفيد-19، حيث توفر مؤشرات الدم غير الطبيعية أدلة مبكرة. ومع ذلك، ينبغي للتفسير أن يأخذ في الاعتبار القيود وحجم العينة والتحيزات المحتملة.

الكلمات المفتاحية: المؤشرات الدموية، كوفيد-19، مركز العزل، قلة اللمفاويات.

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