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DOI: 10.46903/gjms/22.04.1732

ORIGINAL ARTICLE

EFFECT OF COVID 19 ON HEMATOLOGICAL PARAMETERS DURING HOSPITAL ADMISSION

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ABSTRACT

Background: The COVID-19 pandemic, caused by SARS-CoV-2, has significantly impacted global health systems. This study aimed to investigate the effects of COVID-19 on hematological parameters in hospitalized patients in the Kurdistan region of Iraq, focusing on how these parameters are related to patient outcomes.

Materials & Methods: This retrospective observational hospital-based study analyzed data from patients admitted to a COVID-19 infection hospital in the Koya district (MAD center) in Kurdistan from January 2023 to April 2023. In total, 230 patients were included in this study. Hematological parameters, such as blood urea, serum creatinine, hemoglobin, white blood cell (WBC) count, neutrophil count, lymphocyte count, and platelet count were recorded.

Results: The median (interquartile range) age was 66.5 (24.25) years. Among these patients, 65 (28.3%) had hypertension, 49 (21.3%) had diabetes, and 23 (10%) had ischemic heart disease. Significant positive correlations were observed between D-dimer levels and WBC count ($r=0.196$, $P\leq0.010$), neutrophil count ($r=0.125$, $P\leq0.021$), blood urea ($r=0.145$, $P\leq0.027$), and length of hospital stay ($r=0.178$, $P\leq0.007$). Logistic regression indicated that each unit increase in SPO2, with or without oxygen (OR=0.941, $P\leq0.006$; OR=0.961, $P\leq0.008$, respectively), decreased the odds of a worsening patient condition. Conversely, increases in CRP (OR=1.006, $P\leq0.014$) and serum ferritin (OR=1.001, $P\leq0.011$) slightly increased odds.

Conclusion: Monitoring hematological parameters such as D-dimer, CRP, and serum ferritin is essential for managing COVID-19 patients. These parameters are critical for the follow-up of patients with COVID-19 pneumonia and provide insights into the severity of the infection and mortality risk.

Keywords: COVID-19, hematological parameters, D-dimer, SPO2, CRP, serum ferritin, patient outcomes, Kurdistan, hospital admission.

Cite as: Shawgery HR. Effect of Covid 19 on hematological parameters during hospital admission. Gomal J Med Sci 2024 Oct-Dec ;22(4):328-34. https://doi.org/1046903/gjms/22.04.1732

INTRODUCTION

The rapid and unexpected spreading of COVID-19 prompted the World Health Organisation to officially classify it as a worldwide pandemic issue.[1] The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had profound impacts on virtually every aspect of human being. The diagnosis of COVID-19 is made by antibody or CT scan of chest.[2] Since its initial outbreak in late 2019, the virus has spread rapidly, leading to an unpredicted public health crisis that has necessitated extraordinary precautions from governments, healthcare systems, and individuals worldwide.[3] The effects of COVID-19 are multifaceted, encompassing health, economic, social, and psychological dimensions.[4] The immediate and most apparent impact of COVID-19 has been on global health.[1] The virus has caused millions of deaths and left countless others grappling with long-term health consequences, known as "long COVID." Healthcare systems across the globe were overwhelmed, with hospitals facing shortages of beds, ventilators, and personal protective equipment.[5] The urgency of the situation accelerated medical research, leading to the rapid development and deployment of vaccines. Despite these advances, disparities in vaccine access and distribution highlighted and exacerbated existing inequalities within and between countries.[6] These effects have been found in Iraq and Kurdistan region as well.[7] High D-dimer titers and higher admission levels were associated with poor clinical outcomes, namely a rise in assisted ventilation and fatality rates. Regardless of a patient's clinical status, assessing D-dimer changes early in the COVID-19

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Date Submitted: 30-04-2024
Date Revised: 09-10-2024
Date Accepted: 11-11-2024

course may allow doctors the opportunity to put preventative measures in place before these unfavourable consequences occur.[8] A specific area of interest for investigation is the thrombosis associated with this unusual viral pneumonia.[9] Unlike patients with community-acquired pneumonia, COVID-19 patients appear to have a heightened thrombotic complication to the virus.[10] There is a correlation between these patients' micro thrombosis burden and occurrence and worse outcomes.[10] Other factors such as presence of co-morbidity and chronic diseases were not identified to see the effect of the disease on the patients during hospital stay, therefore the current study deals with the haematological parameters during the patient's admission in hospital in Kurdistan regio,- Iraq.

MATERIALS AND METHODS

Study design and settings: This retrospective observational study examined the effects of COVID-19 on hematological parameters in patients admitted to Mad Hospital, a facility dedicated to COVID-19 patients located in the Koisinjaq District of the Kurdistan region, Iraq. This study encompasses two distinct periods: 2020-2021 and January–April 2023. All patients admitted to the hospital during this period were included using a census sampling method. A total of 230 patients diagnosed with COVID-19 were analyzed.

Inclusion and exclusion criteria: This study included all patients admitted to the Mad Hospital during the specified periods, except those with pre-existing hematological disorders or incomplete laboratory data.

Data collection: Upon admission, healthcare workers recorded patient information including age, sex, and any chronic diseases diagnosed by a physician. Various laboratory tests were conducted during the hospital stay and patient outcomes were meticulously documented.

Hematological parameters were assessed using the Lifotronic D-Dimer Assay Kit (Lateral Flow Immunoassay) supplied by Shanghai International Holding Corp. GmbH (Europe), Eiffestrasse 80, 20537 Hamburg, Germany.

Data analysis: Data analysis was conducted using SPSS version 27 and GraphPad Prism for graphical representation. The mean and standard deviation were calculated for parametric data, such as Packed Cell Volume (PCV). Nonparametric data were summarized using median and interquartile ranges. Qualitative variables were reported as frequencies and percentages. The Mann-Whitney U test was used to evaluate non-parametric variable changes, while linear regression was used for further analysis. Subsequently, logistic regression identified significant variable changes, with a p-value ≤ 0.05, considered statistically significant.

RESULTS

A total of 210 patient records were analyzed in this study. The study population was predominantly male, with 133 males (57.8%) and 97 non-smokers (42.2%). Among the patients, 65 (28.3%) had hypertension, 49 (21.3%) had diabetes, and 23 (10%) had ischemic heart disease. The demographic and chronic disease data are presented in Table 1.

Table 1: Patients' demographics and presence of chronic diseases

Variables	Frequency	Percentage
Sex		
Male	133	57.8
Female	97	42.2
Smoking status		
Non-smoker	223	97
Smoker	7	3
COPD		
No	222	96.5
Yes	8	3.5
Bronchial Asthma		
No	228	99.1
Yes	2	0.9
Hypertension		
No	165	71.7
Yes	65	28.3
Diabetes mellitus		
No	181	78.7
Yes	49	21.3
Ischemic heart disease		
No	207	90
Yes	23	10
Chronic renal failure		
No	228	99.1
Yes	2	0.9
Cancer		
No	224	97.4
Yes	6	2.6

The median age was 66.5 years, with an interquartile range (IQR) of 24.25 years. Median values for laboratory parameters included blood urea at 36.25 (IQR: 21.8), serum creatinine at 0.81 (IQR: 0.2), he-

moglobin at 12.5 (IQR: 2.7), white blood cell count at 9.7 (IQR: 6.22), neutrophil count at 7.94 (IQR: 7.16), lymphocyte count at 1 (IQR: 0.72), and platelet count at 193 (IQR: 110.5). The median oxygen saturation (SpO2) was 92 (IQR: 8) with supplemental oxygen and 82 (IQR: 15.25) without supplemental oxygen. The median CRP level was 48 mg/dL, with an IQR of 80.57. D-dimer levels exhibited high variability with a median of 985 and an IQR of 1762.81. The mean PCV was 38.78 with a standard deviation of 5.72, as shown in Table 2.

Table 2: Parameters of the patients

Variable	Result	Variable	Result
Age		Platelet	
Median	66.5	Median	193
Interquartile range	24.25	Interquartile range	110.5
Blood urea		SPO_2 with O_2	
Median	36.25	Median	92
Interquartile range	21.8	Interquartile range	8
Serum creatinine		SPO_2 without O_2	
Median	0.81	Median	82
Interquartile range	0.2	Interquartile range	15.25
Hemoglobin		CRP	
Median	12.5	Median	48
Interquartile range	2.7	Interquartile range	80.57
PCV		D dimer	
Mean	38.78	Median	985
S.D	5.72	Interquartile range	1762.81
WBC		Serum Ferritin	
Median	9.7	Median	538.7100
Interquartile range	6.22	Interquartile range	715.20
Neutrophile		Hospital stay in days	
Median	7.94	Median	5
Interquartile range	7.16	Interquartile range	7
Lymphocyte			
Median	1		
Interquartile range	0.72		

The results showed that 187 (81.3%) patients were alive and 43 (18.7%) died (Figure 1).

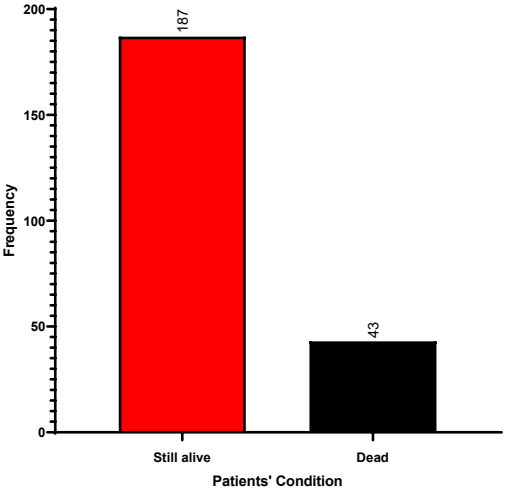

Figure 1: Patient's condition

The correlations between D-dimer levels and various clinical parameters are shown in Figure 2. Significant positive correlations were found between white blood cell count (r=0.196, P≤0.010), neutrophil count (r=0.125, P≤0.021), blood urea level (r=0.145, P≤0.027), and length of hospital stay (r=0.178, P≤0.007). A significant negative correlation was observed between PCV (r=-0.135, P≤0.040).

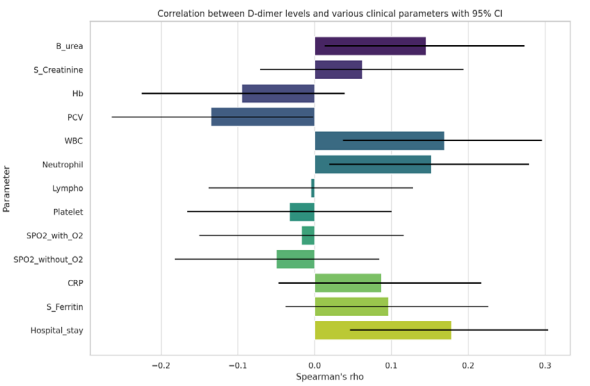

Figure 2: Correlation between D dimer and other Parameters

Logistic regression analysis indicated that each unit increase in SpO2 with supplemental oxygen decreased the odds of worsening the condition by approximately 5.9% (OR=0.941, P≤0.006). Similarly, each unit increase in SpO2 without supplemental oxygen reduced the odds ratio by approximately 3.9% (OR=0.961, P≤0.008). Conversely, each unit increase in CRP level slightly increased the odds of a worsening condition by approximately 0.6% (OR=1.006, P≤0.014), and each unit increase in serum ferritin level increased the odds by approximately 0.1% (OR=1.001, P≤0.011).

Table 3: Adjusted odds ration patients' condition and parameters

Variables	Beta	P value	Odds ratio
SPO_2 with O_2	-0.061	0.006	0.941
SPO_2 without O_2	-0.04	0.008	0.961
CRP	0.006	0.014	1.006
Serum ferritin	0.001	0.011	1.001
Constant	5.95	0.001	383.81

The results in Figure 3 show that Age was positively correlated with blood urea (rho=0.213, 95% CI: 0.082-0.336, P≤0.001) and D-dimer levels (rho=0.224, CI: -0.273, -0.012, P≤0.001). Additionally, there was a weak negative correlation between age and SpO2 without supplemental oxygen (rho=-0.145, CI: -0.273, -0.012, P≤0.025).

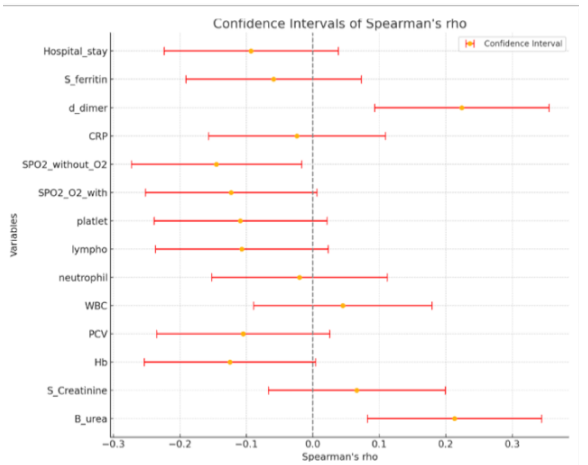

Figure 3: Correlation between age and other parameters.

DISCUSSION

This study aimed to investigate the effects of COVID-19 on hematological parameters in hospitalized patients in the Kurdistan region of Iraq. Positive correlations with parameters such as WBC count, neutrophil count, blood urea, and hospital stay suggest that higher D-dimer levels are associated with higher values of these clinical parameters and longer hospital stay. The negative correlation with PCV indicated that higher D-dimer levels were associated with lower packed cell volume. Furthermore, the patient's condition depends on SPO_2 with or without O_2 and increasing levels of CRP and Serum ferritin. Additionally, age positively affects blood urea and D-dimer levels. Age negatively affects HB and SPO2 levels.

The data showed a positive correlation between age and blood urea as individuals become older, and the ability of the kidneys to filter blood decline, potentially leading to higher levels of blood urea nitrogen (BUN). This finding is consistent with existing literature that suggests a decline in renal function with age, leading to elevated BUN levels.[11]

While there is a trend toward lower hemoglobin levels with increasing age, evidence is insufficient to establish a definitive relationship. Previous studies have suggested that aging may be associated with a slight decline in hemoglobin levels due to factors such as decreased bone marrow activity and a higher prevalence of chronic diseases. The weak negative correlation between age and SPO2 without supplemental oxygen indicates a slight decrease in peripheral oxygen saturation with age, possibly due to age-related changes in respiratory function and gas exchange efficiency.[12]

Elevated D-dimer levels in older adults may indicate an increased risk of thrombotic events, aligning with the understanding that the coagulation system becomes more active with age, leading to a higher risk of blood clots.[1314] Higher admission and peak D-dimer readings are linked to worse clinical outcomes, including increased rates of intubation and mortality. Identifying D-dimer patterns early in the COVID-19 disease course may provide opportunities for early intervention to prevent these adverse outcomes.[8] A study by Lehman and colleagues noted that D-dimer levels remain elevated in 15% of patients who have recovered from COVID-19.[15]

The correlation between age and the other clinical parameters was not statistically significant. This suggests that within the sample studied, these parameters did not show a significant association with age. It is important to consider that the lack of statistical significance does not necessarily imply the absence of any relationship but could be due to the limitations in sample size or variability within the data.

These findings highlight significant correlations between age and several key clinical parameters, including blood urea, SPO_2 without O_2, and D-dimer, underscoring the impact of aging on renal function, respiratory efficiency, and coagulation. While the correlation between age and hemoglobin level was marginally significant, further research with larger sample sizes may be necessary to elucidate this relationship. Understanding these associations is crucial for managing older adult patients and potentially guiding interventions to mitigate age-related declines in these parameters. Previously it was proved that with increase age all the parameters will be changed however, this will be different according to the sex difference.[16]

The analysis revealed important associations between certain clinical parameters and odds of a specific health outcome. According to the relationship of SPO2 with supplemental oxygen, the chance of the result decreased by approximately 5.9%, which is significant and suggests that higher oxygen satura-

tion levels and supplemental oxygen are associated with better health outcomes. Recent studies support this observation, emphasizing that maintaining optimal oxygen levels in patients requiring supplemental oxygen can significantly improve survival rates and reduce complications.[17]

According to the relationship of SPO2 without supplemental oxygen, the chance of the result decreased by about 3.9% this relationship is statistically significant, indicating that better baseline oxygen saturation is associated with more favourable outcomes. This aligns with current research showing that lower baseline oxygen levels are predictive of poorer outcomes in various conditions, including chronic obstructive pulmonary disease (COPD) and other respiratory illnesses.[18]

CRP is a well-known marker of inflammation, and elevated CRP levels are often associated with worse outcomes in various diseases including cardiovascular diseases and infections. Recent studies confirm that higher CRP levels correlate with increased morbidity and mortality, highlighting the importance of inflammation control in patients' management, in this study, a positive correlation between CRP and outcome was also shown.[19-21]

Serum ferritin is marker of iron storage and can be elevated in inflammatory states. Elevated serum ferritin has been associated with adverse outcomes in various conditions, including infections and chronic diseases, owing to its role as an acute-phase reactant. The recent literature emphasizes that higher ferritin levels can indicate severe disease and poorer prognosis, making it a crucial parameter in clinical evaluation of ill patients, in this study, a positive correlation between Serum ferritin and outcome was also shown.[22, 23] The analysis of the correlations between D-dimer levels and various clinical parameters revealed significant relationships that are critical for understanding patient health outcomes.

Elevated WBC counts often indicate an inflammatory or infectious process that can stimulate the coagulation system and increase D-dimer levels. Recent studies have shown that higher D-dimer levels are associated with elevated WBC counts in conditions such as sepsis and COVID-19, where both inflammation and coagulation pathways are activated.[24]

D-dimer levels were also positively correlated with neutrophil count. Neutrophilia, or elevated neutrophil count, is typically a response to acute inflammation or infection. This correlation suggests that conditions causing neutrophilia may also elevate D-dimer levels, reflecting an interplay between immune response and coagulation. Recent literature supports this, particularly in the context of acute inflammatory responses and systemic infections where neutrophils and coagulation factors are both prominently involved.[25]

There was a significant positive correlation between D-dimer and blood urea levels. Elevated blood urea level can indicate impaired renal function, which is often observed in critically ill patients. Renal dysfunction can lead to the accumulation of urea and other waste products in the blood and is frequently associated with higher D-dimer levels owing to the increased risk of thrombosis and coagulopathy in patients with renal failure. This association is well-documented in the literature, particularly in studies involving patients with chronic kidney disease or acute kidney injury.[26]

The correlation between D-dimer levels and hospital stay suggests that higher D-dimer levels are associated with longer hospital stay. This may reflect the severity of the illness, as elevated D-dimer levels are often markers of severe underlying conditions, such as sepsis, pulmonary embolism, or other thrombotic events, which can prolong hospitalization. Current research highlights those patients with elevated D-dimer levels typically require more intensive care and have longer recovery periods, thereby extending their hospital stay.[24]

A significant negative correlation was found between D-dimer levels and packed cell volume (PCV). Lower PCV, indicative of anaemia or reduced red blood cell mass, can be associated with higher D-dimer levels. Anemia and low PCV can result from chronic disease, inflammation, or acute bleeding, all of which can elevate D-dimer levels. The literature supports this negative correlation, particularly in chronic inflammatory conditions and acute bleeding scenarios where both D-dimer levels rise and PCV drops.[27]

The current study has some limitations: First, the sample size still needs to be larger to obtain better results, and some of the patients should be excluded because the absence of laboratory tests could be effective for the current result. Finally, the presence of other comorbidities, especially other infections that were not described in the data, might also have affected the results.

CONCLUSION

Based on these findings, a significant relationship between oxygen saturation, both with and without supplemental oxygen, was shown in the patient's results, and it was shown that maintaining higher levels of SPO2 is associated with reducing the likelihood of adverse outcomes. Increased serum CRP and ferritin levels are associated with an increased likelihood of negative outcomes. Correlations identified between D-dimer levels and clinical parameters, such as WBC count, neutrophil count, blood urea, and hospitalization, highlighted the significant impact of coagulation and inflammation on patient outcomes. Considering the negative correlation between PCV and patient outcomes, it is important to pay attention to the complexity of the interactions between coagulation

and blood parameters, especially in the context of anemia. These insights are critical for optimizing patient management and prognosis.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	HRS
Acquisition, Analysis or Interpretation of Data:	HRS
Manuscript Writing & Approval:	HRS

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.