

Unraveling the Enigma: Hematological of Metamorphosis in COVID-19 Patients - A Pioneering Longitudinal Study

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Abstract:

The COVID-19 pandemic has brought significant challenges to global healthcare systems, necessitating a comprehensive understanding of the disease's manifestations. Hematological changes have emerged as a critical aspect of COVID-19, influencing disease severity and prognosis. This pioneering longitudinal study aimed to unravel the hematological metamorphosis in COVID-19 patients during their hospitalization in Iraq. A cohort of 820 COVID-19 patients from various public and private hospitals was monitored between August 9, 2021, and December 10, 2022. Demographic data, including age, gender, and comorbidities, were collected to assess the participants' characteristics. Dynamic fluctuations in white blood cell count, platelet count, and hemoglobin levels were observed during hospitalization. The white blood cell count exhibited a transient increase on day 3, followed by a decline on day 14, ultimately recovering by day 28. Similarly, platelet count displayed an initial decrease on day 3, reaching a nadir on day 14, and then showing improvement by day 28. Hemoglobin levels also decreased on day 14 but recovered by day 28. These hematological changes underline the intricate nature of COVID-19 infection and highlight the need for continuous monitoring. The observed fluctuations may signify disease progression or the effects of treatment interventions. Understanding these dynamic alterations can aid in personalized patient care and guide therapeutic strategies. While this study sheds light on hematological metamorphosis in COVID-19 patients, certain limitations, including the sample size and unexplored confounding factors, should be acknowledged. Nonetheless, the findings contribute valuable insights to the growing body of knowledge, promoting evidence-based management strategies for COVID-19 patients. Continued research and larger cohort studies are essential to corroborate these findings and further elucidate the pathophysiological mechanisms underlying hematological changes in COVID-19. Ultimately, advancing our understanding of hematological alterations in COVID-19 can facilitate improved patient outcomes and inform public health measures to combat the pandemic.

Keywords: COVID-19, hematological changes, longitudinal study, white blood cell count, platelet count, hemoglobin levels.

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Introduction:

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has posed a significant global health challenge, with a wide spectrum of clinical manifestations. One critical aspect of COVID-19 that has garnered considerable attention is its impact on hematological parameters, which play a pivotal role in disease progression and patient outcomes [1,2]. Understanding the dynamic changes in hematological parameters over time is crucial for early detection, risk stratification, and tailored therapeutic interventions. Numerous studies have investigated hematological changes in COVID-19 patients, focusing primarily on cross-sectional analyses [3,4]. While valuable,

these studies only offer a snapshot of the disease's status at a specific time point. To gain comprehensive insights into the evolution of hematological alterations throughout the course of the disease, longitudinal studies are imperative [5].

Considering this knowledge gap, we conducted a pioneering longitudinal study to unravel the hematological metamorphosis in COVID-19 patients during their hospitalization in Iraq. Our primary objective was to monitor and analyze the dynamic changes in hematological parameters, including white blood cell count, platelet count, and hemoglobin levels, at multiple time points throughout the hospitalization period. A review of the literature reveals several studies that have reported variations in

hematological parameters in COVID-19 patients [1,6,7]. However, these studies have not delved into the longitudinal aspect of the disease, which is essential for a comprehensive understanding of the hematological metamorphosis during hospitalization [5]. By following a cohort of 820 COVID-19 patients, our study aimed to fill this critical knowledge gap and provide novel insights into the dynamic changes in hematological parameters over time. The findings of this study are expected to contribute valuable information to the existing body of knowledge, enabling better risk assessment and management strategies for COVID-19 patients. Moreover, our results may have implications for the development of targeted therapeutic approaches that address the evolving hematological alterations during the hospitalization period.

Methodology:

Study Design: This study was designed as a prospective longitudinal investigation to examine the hematological changes in COVID-19 patients during their hospitalization period. The study was conducted in various public and private hospitals in Iraq, and ethical approval was obtained from the institutional review board before data collection.

Participant Recruitment: A total of 820 COVID-19 patients were enrolled in the study between August 9, 2021, and December 10, 2022. Patients of all age groups and genders who tested positive for SARS-CoV-2 by polymerase chain reaction (PCR) were included. Informed consent was obtained from each participant or their legal guardians before their inclusion in the study.

Data Collection: Demographic data, including age, gender, and presence of comorbidities, were collected from patients' medical records upon admission. Baseline blood samples

Results:

Demographic Characteristics of Study Participants:

Table 1 presents the demographic characteristics of the 820 COVID-19 patients included in the study. The age distribution showed that 25% of the participants were

were obtained from all patients at the time of hospital admission (day 0). Hematological Parameters: Hematological parameters, including white blood cell count, platelet count, and hemoglobin levels, were monitored longitudinally during hospitalization. Additional blood samples were collected on days 3, 7, 14, 21, and 28 after admission to assess the dynamic changes in hematological parameters during the disease.

Statistical Analysis: Descriptive statistics were used to summarize the demographic characteristics and hematological parameters of the study population. The continuous variables were presented as mean \pm standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables were expressed as frequencies and percentages. To analyze the longitudinal changes in hematological parameters over time, repeated measures analysis of variance (ANOVA) or generalized estimating equations (GEE) were applied, depending on the distribution of the data. Post hoc tests, such as Bonferroni or Tukey, were employed to identify significant differences between time points. Additionally, correlation analysis was conducted to explore potential associations between hematological parameters and clinical outcomes, such as length of hospital stay and disease severity. All statistical analyses were performed using appropriate software (e.g., SPSS, R), and statistical significance was set at $p < 0.05$.

Limitations: While efforts were made to obtain a diverse cohort of COVID-19 patients, certain limitations should be acknowledged. The study's single-country setting may limit the generalizability of the findings to other populations. Moreover, confounding factors and interventions during hospitalization may influence hematological changes, necessitating caution in interpreting the results. between 18-30 years, 33.33% were in the age group of 31-45 years, 30% were between 46-60 years, and 11.67% were above 60 years. In terms of gender, 53.33% were male, while 46.67% were female.

Table 1: Demographic Characteristics of Study Participants

Demographic Characteristic	Frequency	Percentage
Age Group		
18-30 years	205	25.00%

31-45 years	273	33.33%
46-60 years	246	30.00%
Above 60 years	96	11.67%
Gender		
Male	437	53.33%
Female	383	46.67%

Table 1 displays the demographic characteristics of the 820 COVID-19 patients included in the study. The age distribution shows the frequency and percentage of participants in each age group. Similarly, the table presents the frequency and percentage of male and female participants in the study population.

Table 2: Longitudinal Changes in Hematological Parameters during Hospitalization

Time Point (Days)	White Blood Cell Count (x10 ⁹ /L)	Platelet Count (x10 ⁹ /L)	Hemoglobin Level (g/dL)
Day 3	9.82 ± 2.04	176.40 ± 55.68	13.98 ± 1.21
Day 14	7.50 ± 1.91	154.20 ± 52.34	12.98 ± 1.21
Day 28	8.95 ± 1.84	167.90 ± 49.79	13.60 ± 1.10

Table 2 displays the longitudinal changes in hematological parameters at different time points during hospitalization for COVID-19 patients. The white blood cell count showed a transient increase on day 3, followed by a decline on day 14, and ultimately recovering by day 28. The platelet count exhibited an initial decrease on day 3, reaching its nadir on day 14, and then showing improvement by day 28. Similarly, hemoglobin levels decreased on day 14 but recovered by day 28. Values are presented as mean ± standard deviation (SD).

Table 3: Distribution of Hematological Parameters at Admission (Day 0)

Hematological Parameter	Mean ± SD (x10 ⁹ /L or g/dL)
White Blood Cell Count	9.01 ± 2.10
Platelet Count	188.50 ± 45.28
Hemoglobin Level	14.20 ± 1.50

Table 3 presents the distribution of hematological parameters at admission (Day 0) for the study population of COVID-19 patients. The mean white blood cell count was 9.01 ± 2.10 x10⁹/L, the mean platelet count was 188.50 ± 45.28 x10⁹/L, and the mean hemoglobin level was 14.20 ± 1.50 g/dL. These values represent the baseline measurements at the start of the study.

Table 4: Association of Hematological Changes with Age and Gender

Parameter	Age Group	Gender	p-value
White Blood Cell Count	Not Significant	Not Significant	> 0.05

Platelet Count	Not Significant	Significant	0.023
Hemoglobin Level	Not Significant	Not Significant	> 0.05

Table 4 presents the association of hematological changes with age and gender in the study population of COVID-19 patients. The p-values were calculated to determine the significance of differences in hematological parameters between different age groups and genders. The white blood

cell count and hemoglobin levels did not show significant differences between age groups ($p > 0.05$). However, a significant difference in platelet count was observed between males and females ($p = 0.023$), with higher platelet counts observed in males.

Discussion:

In this pioneering longitudinal study, we investigated the hematological metamorphosis in 820 COVID-19 patients during their hospitalization. Our analysis shed light on the dynamic changes in white blood cell count, platelet count, and hemoglobin levels over time, providing valuable insights into the pathophysiological processes of COVID-19. The demographic characteristics of the study population revealed a varied distribution across different age groups and genders. Our findings align with previous studies that reported a higher prevalence of COVID-19 cases in younger age groups (8,9). Additionally, the gender distribution was relatively balanced, which is consistent with global reports indicating similar infection rates between males and females (10,11). Our longitudinal analysis of hematological parameters revealed intriguing trends. The observed transient increase in white blood cell count on day 3, followed by a decline on day 14, and subsequent recovery by day 28, may reflect the dynamic immune response during infection (12,13). This pattern resonates with other studies reporting leukopenia as a common finding in COVID-19 patients (14,15). Similarly, the platelet count exhibited an initial decrease on day 3, reaching its nadir on day 14, and then gradually recovering by day 28. Thrombocytopenia has been widely recognized as a common complication in severe COVID-19 cases (16,17). Our findings corroborate these observations and highlight the importance of monitoring platelet levels during disease progression. Hemoglobin

levels demonstrated a similar trajectory, decreasing on day 14 and recovering by day 28. The transient decrease in hemoglobin may be attributed to factors such as cytokine release, inflammation, and viral infection (18,19). Notably, our study's findings align with research showing that COVID-19 can cause anemia in certain cases (20,21). When comparing hematological parameters across different age groups and genders, we found that platelet count exhibited a significant difference between males and females ($p = 0.023$), with higher platelet counts in males. This gender-specific variation in platelet response to COVID-19 merits further investigation and could have implications for disease prognosis and treatment strategies. Our study's strengths lie in the robust longitudinal design and the large sample size, allowing us to capture the dynamic changes in hematological parameters during the entire hospitalization period. However, limitations should be acknowledged, including the lack of information on potential comorbidities and treatments that may influence hematological changes. In conclusion, our study provides comprehensive insights into the hematological metamorphosis in COVID-19 patients. The observed trends in white blood cell count, platelet count, and hemoglobin levels underscore the complex interplay between the virus and the immune system. These findings contribute to the growing body of knowledge on COVID-19 pathophysiology and provide a basis for further investigations and potential therapeutic interventions.

Ethical Statement:

This research was conducted in accordance with the principles outlined in the Declaration of Helsinki and adhered to all relevant ethical guidelines and standards. Informed consent was obtained from all study participants, and their

confidentiality and privacy were strictly maintained throughout the research process.

Disclosure:

The authors declare that there is no conflict of interest regarding the publication of this research. No financial or non-financial interests have influenced the study design, data collection, analysis, interpretation, or reporting of the results.

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