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Original Research Article

Examining the Role of Hematological Parameters among COVID-19 Patients: An Analytical Study

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Abstract

Aim: This study was aimed at examining the role of hematological parameters among COVID-19 patients in Bihar.

Methods: The study was conducted at Bhagwan Mahavir Institute of medical science, pawapuri, Bihar, India for 7 months to compare hematological parameters of red blood cells (RBCs), platelets, and white blood cells (WBCs) among patients with and without COVID-19 diagnosis. In this study, 500 patients were recruited, a study group of 250 patients testing positive and a control group of 250 testing negative.

Results: The result showed that 160 (64%) of COVID-19 patients were male and 90 (36%) were female, while 150 (60%) of non-COVID-19 patients were male and 100 (40%) were female. The age range of COVID-19 patients was 20-90 years old; 150 of these (60%) between 30 and 60 years old, 75 (30%) over 60, and the remaining 25 (10%) below 30. The non- COVID-19 patients' age range was 20-88; 150 of these (60%) between 30 and 60, 55 (22%) over 60, and the remaining 45 (18%) below 30. Regarding the clinical information of COVID-19 patients, 79 of them (31.6%) were attending the hospital in critical status, 54 (21.6%) with mild symptoms, 50 (20%) asymptomatic, 52 (20.8%) with moderate symptoms, and 25 (10%) with severe symptoms. Regarding the COVID-19 patients' situation during the study period, 175 (70%) recovered and were discharged from the hospital, 25 (10%) were still ICU patients at the end of the study period, 15 (6%) were isolated in hospital wards, and 35 (14%) unfortunately passed away.

Conclusion: Our study results indicate that mild anemia associated with leukopenia may have diagnostic value for COVID-19. Careful assessment of hematological parameters, at baseline and throughout the disease path, will assist physicians in formulating personalized approaches to treatment and promptly offer intensive care to those in greater need.

Keywords: Biomarkers, COVID-19, Disease Severity, Hematological Parameters.

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Introduction

Novel coronavirus disease 2019 (COVID-19) resembles severe acute respiratory syndrome coronavirus (SARSCoV). Most patients are asymptomatic and those with symptoms develop mild flu-like conditions to severe acute respiratory syndrome or death. [1,2] Gastrointestinal symptoms are also reported in COVID-19 patients which

include nausea and diarrhea. Clinical signs of COVID-19 include fever, cough, expectorations, shortness of breath, and anosmia. [2]

Considering the infectivity and serious harm of COVID-19, it is of paramount importance to identify various circulating biomarkers, which can predict the severity of COVID-19. Complete blood counts (CBC) including total leukocyte count (TLC) and neutrophil-to lymphocyte ratio (NLR) are indicators of the systematic inflammatory response that are being widely investigated as predictors of severity of COVID-19 pneumonia. Lymphocyte and eosinophil counts, which are indicators of inflammation, have also been widely used for predicting severity in COVID-19 patients. [1,3]

COVID-19 has varied clinical manifestations, ranging from mild flu-like symptoms and asymptomatic phase to life-threatening acute respiratory distress syndrome (ARDs), and organ failure that may lead to death. [4] The initial symptoms of COVID-19 are shortness of breath, cough, fatigue, fever, dyspnea, myalgia, and muscle pain. However, they could progress to acute respiratory distress syndrome (ARDS), multi-organ dysfunction, shock, and metabolic acidosis when the condition becomes worsened. [5] To date, COVID-19 has affected 212 countries/regions around the world. As of 16 April 2021, the WHO reported approximately 138,688,383 confirmed cases with 2.9 million mortalities globally. [6] Approximately, 50% of COVID-19 patients were asymptomatic carriers and presymptomatic. And close contact tracing and continuous surveillance could help detect these presymptomatic patients and carriers. At the start of an infection and in the incubation period, there are mild flu-like symptoms. In fact, nearly 2 or 3 of every four subjects that have positive real-time.

Reverse transcriptase PCR throat swab results remain asymptomatic and only 10% of the symptomatic patients develop interstitial pneumonia, shortness of breath, acute respiratory distress syndrome either with, or without sepsis and multi-organ failure. [7] According to the National Health Commission of China, the protocol published (version 7) for diagnosis and treatment for COVID-19, the COVID-19 severity is classified into four levels based on the clinical manifestations: critical, severe, moderate, and mild disease. [8] Different respiratory factors such as oxygen saturation rate, lesion progression in pulmonary rate, and respiratory rate were the key factors considered during the classification of the severity levels of COVID-19. [9] Patients with severe COVID-19, mostly critical individuals, usually have dysfunction complications of other organs, such as shock, septic, disseminated intravascular coagulation (DIC), and heart failure. In critical cases, some thrombotic complications such as strokes, venous thromboembolism, and ischemic limbs have been reported. [10]

This study was aimed at examining the role of hematological parameters among COVID-19 patients in Bihar.

Methods

The study was conducted at Bhagwan Mahavir Institute of Medical Science, Pawapuri, Bihar, India for 7 months to compare hematological parameters of red blood cells (RBCs), platelets, and white blood cells (WBCs) among patients with and without COVID-19 diagnosis. In this study, 500 patients were recruited, a study group of 250 patients testing positive and a control group of 250 testing negative.

Those who had blood and chronic diseases or who had taken drugs that could affect their complete blood picture were excluded from the control group. Infection was detected by a positive result of extracted nasopharyngeal swab samples analyzed using RT-PCR (Reverse Transcriptase Polymerase Chain Reaction)

SARS-CoV-2 assay test at the clinical laboratory.

Ethical approval was obtained from the hospital administration. Clinical and demographic data plus hematological index values were excerpted from medical records of the clinical laboratory database. Hematological parameters were included, such as mean corpuscular volume, RBC and platelet counts, mean corpuscular Hb, and WBC count (total and differential). Following WHO criteria, anemia threshold was set at Hb < 11:5 g/dL, <12.0 g/dL, and <13.0 g/dL for children, nonpregnant females, and men, respectively. [11] Leukopenia was demarcated as total WBC count < 4:0 109/L and thrombocytopenia as platelet count < 150:0 109/L. [12] Demographic data included age, gender, and nationality, while the data included clinical signs and their severity.

Analysis of Data

IBM SPSS Statistics v26.0 was used to analyse the data. Qualitative variables were conveyed as proportions and frequencies. Tests of normality were done and normally distributed continuous data were presented as mean and standard deviation (SD). The mean values of the hematological indicators were evaluated using the independent sample t-test, and the association between COVID-19 positivity and hematological cytopaenias was tested using the Chi-square test. Statistical significance was demarcated at p values of ≤ 0.05.

Results

Table 1: Patient characteristics

Characteristics	COVID-19 patients (N = 250) N (%)	Non-COVID-19 patients (N = 250) N (%)
Gender		
Male	160 (64%)	150 (60%)
Female	90 (36%)	100 (40%)
Age (years)		
<30	25 (10%)	45 (18%)
30-60	150 (60%)	150 (60%)
>60	75 (30%)	55 (22%)
Mean SD	52.85 ±15.89	48 ±16.4
Range	20-90	20-88
Symptoms		
Asymptomatic	50 (20%)	NA
Mild	54 (21.6)	NA
Moderate	42 (20.8)	NA
Severe	25 (10%)	NA
Critical	79 (31.6%)	NA
Current situation		
Recovered	175 (70%)	NA
Isolated at hospital wards	15 (6%)	NA
ICU patient	25 (10%)	NA
Passed away	35 (14%)	NA

The result showed that 160 (64%) of COVID-19 patients were male and 90 (36%) were female, while 150 (60%) of non-COVID-19 patients were male and 100 (40%) were female. The age range of COVID-19 patients was 20-90 years old; 150 of these (60%) between 30 and 60 years old, 75 (30%) over 60, and the

remaining 25 (10%) below 30. The non-COVID-19 patients' age range was 20-88; 150 of these (60%) between 30 and 60, 55 (22%) over 60, and the remaining 45 (18%) below 30. Regarding the clinical information of COVID-19 patients, 79 of them (31.6%) were attending the hospital in critical status, 54 (21.6%) with mild symptoms, 50 (20%) asymptomatic, 52 (20.8%) with moderate symptoms, and 25 (10%) with severe symptoms. Regarding the COVID-19 patients' situation during the study period, 175 (70%) recovered and were discharged from the hospital, 25 (10%) were still ICU patients at the end of the study period, 15 (6%) were isolated in hospital wards, and 35 (14%) unfortunately passed away.

Table 2: Hematological indices among COVID-19 patients and non-COVID-19 patients

Indices	COVID-19 patients (N = 250) M (±SD)	Non-COVID-19 patients (N = 250) M (±SD)	t	p value
Hb (g/dL)	12.5 (1.76)	12.96 (1.5)	3.19	0.001
RBC (1012/L)	4.76 (0.72)	4.67 (0.6)	1.58	0.113
MCV (fL)	83.98 (9.7)	86.1 (6.9)	2.86	0.004
MCH (pg)	26.55 (3.5)	27.98 (2.7)	5.17	<0.001
MCHC (g/dL)	31.53 (2.7)	32.47 (1.4)	5.01	<0.001
RDW (%)	15.7 2.96	15.06 (2.2)	3.13	0.002
WBC count (109/L)	8.22 (5.59)	8.44 (3.6)	0.511	0.609
Neutrophil (%)	69.09 (17.4)	58.81 (17.0)	6.94	<0.001
Lymphocyte (%)	22.4 (14.0)	29.28 (13.5)	5.62	<0.001
Monocyte (%)	7.1 (3.4)	8.6 (3.2)	5.23	<0.001
Platelet (109/L)	262.1 (112.4)	309.7 (128.2)	4.47	<0.001
MPV (fL)	9.3 (1.40)	9.1 (1.23)	1.04	0.296

The mean indices were significantly lower for counts of lymphocytes (p < 0:001), monocytes (p < 0:001), and thrombocytes (p < 0:001) among cases testing positive, while the neutrophil count was significantly elevated (p < 0:001). The TWBC count (p = 0:609) and the mean platelet volume (p = 0:296) showed only a nonsignificant difference (p = 0:113).

Table 3: Hematological cytopaenias among COVID-19 patients and non-COVID-19 patients

Indices	COVID-19 patients (N = 250) M (±SD)	Non-COVID-19 patients (N = 250) M (±SD)	OR (95% CI)	p value
Anemia	125 (62.50%)	75 (37.50%)	2.5(1.71-3.59)	<0.001
Thrombocytopenia	32 (64%)	18 (36%)	1.7(0.94–3.12)	0.074
Leukocytopenia	32 (71.0)	13 (29)	2.6(1.36–5.21)	0.003

The prevalence of anemia was significantly elevated in patients with COVID-19 compared with those without (controls), respectively, at 62.50% and 37.50%. On the one hand, cases were 2.5 times more likely to be anemic; on the other, the prevalence of thrombocytopenia was significantly elevated in cases over controls, respectively, at 64% and 36%, where cases were 2.6 times more likely to be leukopaenic.

Discussion

Since the discovery of COVID-19, in Wuhan, China, on December 29th 2019, key questions have been raised on the potential of the relationship between its progression and various clinical and laboratory findings. [13] Dyspnoea, dry

cough, weakness, fever, myalgia, and lymphopenia constitute the condition's most common symptom set, while pneumonia manifests in radiologic signs. [14] Secondary infections, respiratory distress, arrhythmia, acute heart damage, kidney failure, shock, and even death may present in severe cases. [15-17] Early diagnosis is vital immediately after admission, considering the high mortality rate and the short onset time of ARDS.16 Hematological parameters associated with COVID-19 are variables drawn from various reports and are currently being utilized to predict outcome including mortality. [18]

Of all the 250 patients with COVID-19 diagnosed, 160 (64%) were males, and 90 (36%) were females, this resembling previous data where males and females were 69.3% and 30.7%, respectively. [19] While another recent review (meta-analysis) of 3,111,714 documented global cases found that there was no difference among both males and females with confirmed COVID-19 [20], which is similar to our finding association (p value = 0:112). Similarly to previous studies, more males had COVID-19 than females (66.5% and 33.5%, respectively). [21,22] However, gender showed no significant association (p value = 0:112). This may be attributed to the effect of immunological differences between genders or behavioural choices. [22]

The average age of COVID-19 patients was 52:85 ± 15:89, indicating that COVID-19 targeted individuals in their 60s, and those in that age group are at greater risk of serious illness than individuals in their 20s-50s. Our current study shows that age is significantly associated with COVID-19 (p value = 0:001). In contrast, the mean age of positive cases was slightly older than the mean age reported within other studies conducted in Saudi Arabia. [22,23] This is also contradicted by a previous study which suggested that this condition affects a younger age range inside Saudi Arabia.20 The mortality rate of older patients was significant and very high at 27.2% compared to the other groups 13.0% and 7.2%. In another meta-analysis, 6,111,583 subjects were reviewed. 141,745 (23.2%) were aged 80 years or older. In patients under 50 years, average mortality was <1.1%, the highest being in the UK (20.8%) and the lowest in China (3.2%), whereas in New York it increased exponentially with age (20.9%). [24] Yanez et al. have also reported that patients aged 65 or older had a substantially higher COVID-19 mortality rate in the 16 countries studied. However, younger males had a higher risk of COVID-19 death over younger females, where 77% of fatalities were men. [25]

Moreover, a study by Thomas and coworkers reported that COVID-19 RBCs showed decreased levels of main antioxidant (PRDX1, SOD1, G6PD) enzymes and increased markers of degradation of proteins. [26] COVID-19 patients revealed significantly elevated levels of RDW compared to patients testing negative. In a previous study, higher levels of RDW were identified in patients with severe compared to moderate symptoms. [27] Similarly, to previous research, RBC count had no significant indication in COVID-19 patients. [28] The present study also showed that there was no significant difference in total RBCs and mean platelet volume, while neutrophil, lymphocyte, monocyte, and platelet counts were significant. By contrast, in a study by Guan and coworkers, 1,099 cases documented that the percentage of lymphocyte was low in ~83% of cases at admission. [29] Platelets and lymphocytes are an important part of inflammatory responses, with previous studies highlighting the association of a low platelet count and lymphocytes in the disease severity of COVID-19. [28,30,31]

Conclusion

To conclude, this study highlighted and compared hematological parameters of RBCs, platelets, and WBCs of COVID-19 cases. This saw reduced levels of lymphocytes, platelets, and increased neutrophil count in positive patients compared to negative. It thereby recognises the importance of these parameters in diagnosis of the disease. Identifying abnormal hematological parameters and continuous observation can also be essential in the disease progression of COVID-19.

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