

Research Article

Haematological and Biochemical Parameters in COVID-19 Patients Attending a Tertiary Care Hospital: A Retrospective Study

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A B S T R A C T

Introduction: The SARS-CoV-2 RNA virus, which causes COVID-19 disease, rapidly spread to the entire world. COVID-19 mainly involves the respiratory tract, now found to be linked with systemic diseases due to multiple organ involvement. Limited data are available regarding the effect of COVID-19 on various haematological and biochemical parameters.

Materials and Methods: A retrospective cross-sectional study was carried out on 400 cases from March 2021 to August 2021. Two hundred COVID-19 RT-PCR confirmed cases formed the study group and 200 subjects who tested negative were included in the controls to study various haematological and biochemical parameters.

Results: Thrombocytopenia was significantly noticed in cases as compared to controls (65.3% and 34.7%, respectively), with cases 2.45 times more likely to be thrombocytopenic ($p < 0.01$). Leucopenia was 1.79 times higher in cases (62.8%) in comparison to controls (37.2%). Moreover, positive cases were 1.35 times more anaemic than control. The mean indices for serum bilirubin ($p = 0.020$), serum creatinine ($p < 0.001$), alanine transaminase ($p = 0.081$), blood urea ($p < 0.001$), procalcitonin ($p < 0.001$) and c-reactive protein ($p < 0.001$) were significantly raised in cases in comparison to controls.

Conclusion: Thrombocytopenia, leucopenia along with raised serum bilirubin, creatinine, ALT, AST, CRP and procalcitonin may be beneficial in the diagnosis of COVID-19. Meticulous assessment and correlation of haematological and biochemical parameters at the time of admission and simultaneously during the disease course will be helpful to physicians in formulating individualised treatment along with decision-making regarding requiring intensive care to those in need.

Keywords: Biochemical Marker, COVID-19, Haematological Parameter, Thrombocytopenia, Leucopenia

Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) RNA virus, rapidly spread to the whole world. World Health Organization (WHO) in January 2020, declared this infection to be a pandemic which affected approximately 194 million people and caused 4.1 million deaths across the whole world.¹ SARS-COV-2 is very closely related to SARS-COV and invasive in nature through surface angiotensin-converting enzyme-2 (ACE-2) receptors.² Although COVID-19 mainly causes a respiratory tract infection, now has been found to be associated with systemic diseases due to multiple organ involvement, including the gastrointestinal, cardiovascular, neurological, haematopoietic and immune systems.³⁻⁵ The common symptoms of COVID-19 infection are fever, throat inflammation and also can lead to various conditions, including respiratory, neurological, enteric, cardiac or secondary infections.^{6,7}

The COVID-19 infection in our country disturbs and disrupts health services in various manners. Studies on COVID-19 showed an increase in cardiovascular complications due to the COVID-19 lockdown and also because of diabetes-related complications. In the COVID-19 pandemic, cost-effective utilisation of limited resources is of utmost importance. Haematological parameters and biochemical markers may be helpful to physicians to identify the severity of infection in patients. While considering the fast onset of acute respiratory distress syndrome (ARDS) and higher chances of mortality among hospital-admitted COVID-19 patients, early diagnosis is of utmost significance.⁸ A complete blood count (CBC) can be very beneficial in diagnosis as well as monitoring the disease condition, as it will provide information regarding inflammatory processes like leucocyte count, neutrophil or lymphocyte percentage, N/L ratio, c-reactive protein (CRP), considering these inflammatory markers as the prognostic indicators in COVID-19 positive cases can be of great significance.^{8,9} However, the use of these haematological and biochemical parameters in terms of COVID-19 diagnosis, treatment supervision and risk assessment has not been studied in depth.

Therefore, in the present study, we have studied the haematological and serum biochemical parameters among COVID-19-positive RT-PCR confirmed patients in comparison with negative subjects.

Materials & Methods

A hospital-based, retrospective cross-sectional study was conducted in the Department of Pathology in the Dr Bhimrao Ramji Ambedkar Government Medical College

over a period of 6 months from March 2021 to August 2021 to compare various haematological and biochemical parameters. Two hundred COVID-19 RT-PCR confirmed cases formed the study group and 200 subjects who tested negative were included in the controls. Those patients who had a history of any blood disorder, haematological malignancies, coagulopathies, chronic disease or had taken any type of drugs in the past were excluded from the control group.

Ethical approval was obtained from the Institutional Review Board- IEC/GMC, Kannauj/54. Demographic, haematological and biochemical data were taken from the medical records of the laboratory database. Among the haematological parameters, WBC count, haemoglobin (Hb) and platelet counts were recorded. According to WHO, anaemia was said to be present if haemoglobin (Hb) < 11.5 g/dL for children, < 12.0 g/dL for nonpregnant females, and < 13.0 g/dL for men.¹⁰ Thrombocytopenia was indicated if platelet count < 150.0 × 10⁹/L and leucopenia as total WBC count < 4.0 × 10⁹/L.¹¹ Biochemical parameters include aspartate aminotransferase (AST), alanine transaminase (ALT), serum bilirubin, serum creatinine, urea, blood urea nitrogen, and uric acid. CRP and procalcitonin as inflammatory markers were also studied.

Statistical Analysis

Data of the present study was recorded in Microsoft Office Excel spreadsheet version 2007 and qualitative variables were expressed as percentages and proportions. Normally distributed continuous data was presented as mean and standard deviation (SD). The mean values of the haematological and biochemical parameters were calculated using the t test, and their association with COVID-19 cases were tested using the chi-square test. The results were found to be statistically significant for p values ≤ 0.05.

Results

Table 1 shows that out of 200 cases studied, 124 (62%) were male and 76 (38%) were females while 80 (40%) among controls were male and 120 (60%) were female. The age range of positive cases was 12–95 years old while that of controls was 1–82 years. Out of 200 COVID-19-positive patients, 82 (41%) were attending the hospital with mild symptoms and 55 (27.5%) were asymptomatic. There were 52 patients presented with moderate symptoms and 11 (5.5%) showed severe symptoms.

Table 2 shows that the mean indices for total white blood cell (TWBC) counts were significantly lower in positive cases compared with negative ($p < 0.001$), while the neutrophil counts were significantly higher ($p < 0.001$). The mean indices for haemoglobin concentration ($p = 0.278$), the

lymphocyte counts ($p = 0.597$) and the mean platelet volume showed a non-significant difference ($p = 0.282$).

Table 3 shows that the mean indices for serum bilirubin ($p = 0.020$), serum creatinine ($p < 0.001$), alanine transaminase ($p = 0.081$), blood urea ($p < 0.001$), procalcitonin ($p < 0.001$) and C-reactive protein ($p < 0.001$) were significantly raised in cases in comparison to controls. The levels of aspartate aminotransferase ($p = 0.115$) and uric acid ($p = 0.387$) showed non-significant differences.

Table 4 shows that thrombocytopenia was significantly higher in positive cases as compared to controls (65.3% and 34.7%, respectively). The prevalence of leucocytopenia was also higher in COVID-19-positive cases as compared to negative subjects (62.8% and 37.2%, respectively), if the results were measured at 10% level of significance. The cases were 2.45 times more thrombocytopenic and 1.35 times more likely to be anaemic.

Table 1.Characteristics of Study Subjects

N = 200

Characteristics	Cases (COVID-19 Patients) n (%)	Controls (Non-COVID-19 Patients) n (%)
Gender		
Male	124 (62.0)	80 (40.0)
Female	76 (38.0)	120 (60.0)
Age (years)		
< 30	29 (14.5)	92 (46.0)
30–60	134 (67.0)	85 (42.5)
> 60	37 (18.5)	23 (11.5)
Mean $\pm$ SD	47.96 $\pm$ 14.97	36.90 $\pm$ 17.41
Range	12–95	1–82
Symptoms		
Asymptomatic	55 (27.5)	NA
Mild	82 (41.0)	NA
Moderate	52 (26.0)	NA
Severe	11 (5.5)	NA

Table 2.Haematological Indices among COVID-19 Patients and Non-COVID-19 Patients

N = 200

Indices	Units	SI Reference Range	Cases (COVID-19 Patients) M $\pm$ SD	Controls (Non-COVID-19 Patients) M $\pm$ SD	t	p Value
Haemoglobin	g/dL	13–17	14.08 $\pm$ 0.89	14.24 $\pm$ 0.94	-1.089	0.278
White blood cells	cells/mm ³	4000–10000	6555.41 $\pm$ 1564.26	7387.85 $\pm$ 1685.57	-3.86	< 0.001*
Neutrophil percentage	%	40–80	67.56 $\pm$ 9.18	63.59 $\pm$ 9.19	3.44	< 0.001*
Lymphocytes percentage	%	20–40	28.27 $\pm$ 5.39	27.84 $\pm$ 4.90	0.53	0.597
Platelets	cells/mm ³	150000–450000	218308 $\pm$ 65334.8	209488 $\pm$ 50889.4	1.08	0.282

g/dL: grams per decilitre

* shows the significant result at a 5% level of significance

Table 3. Biochemical Markers and Inflammatory Markers

N = 200

Indices	Units	SI Reference Range	Cases (COVID-19 Patients) M ± SD	Controls (Non-COVID-19 Patients) M ± SD	t	p Value
Aspartate aminotransferase (AST)	IU/L	< 40	27.21 ± 7.16	25.61 ± 7.55	1.58	0.115
Alanine transaminase (ALT)	IU/L	0–45	29.33 ± 8.18	27.71 ± 6.92	1.75	0.081 ⁺
Serum bilirubin	mg/dL	0.0–1.2	0.621 ± 0.207	0.565 ± 0.219	2.32	0.020 [*]
Serum creatinine	mg/dL	0.8–1.3	1.050 ± 0.165	0.940 ± 0.139	5.01	< 0.001 [*]
Urea (BU)	mg/dL	17–50	34.95 ± 7.99	26.52 ± 5.73	11.02	< 0.001 [*]
Blood urea nitrogen (BUN)		-	16.87 ± 9.80	14.31 ± 9.11	2.70	0.007 [*]
Uric acid (UA)	mg/dL	3.5–7.2	4.79 ± 0.99	4.70 ± 0.89	0.87	0.387
C-reactive protein (CRP)	mg/L	< 10	6.23 ± 2.52	4.72 ± 1.63	4.85	< 0.001 [*]
Procalcitonin (Pct)	ng/dL	< 0.1	0.003 ± 0.021	0.020 ± 0.015	4.55	< 0.001 [*]

IU/L: International units per litre, mg/dL: milligrams per decilitre, ng/dL: nanograms per decilitre

* sign shows the significant result at 5% level of significance.

+ sign shows the significant result at 10% level of significance.

Table 4. Haematological Cytopenias among Cases and Controls

N = 200

Haematological Abnormality	Cases (COVID-19 Patients) n (%)	Controls (Non-COVID-19 Patients) n (%)	OR (95% CI)	p Value
Anaemia	106 (53.8)	91 (46.2)	1.35 (0.91, 2.00)	0.1330
Thrombocytopenia	79 (65.3)	42 (34.7)	2.45 (1.58, 3.82)	0.0001 [*]
Leucocytopenia	27 (62.8)	16 (37.2)	1.79 (0.93, 3.45)	0.0780 ⁺

* sign shows the significant result at 5% level of significance.

+ sign shows the significant result at 10% level of significance.

Discussion

COVID-19 disease had seen a rise worldwide. While investigating the COVID-19 outbreak, an assessment of demographic, clinical outcomes and haematological profile is necessary. Thus, this study investigated various biochemical and haematological parameters among COVID-19-positive cases and controls.

Of all the 200 positive cases, 124 (62%) were male and 76 (38%) were female, thus resembling the previous study done by Usul et al.¹² This could be due to immunological and behavioural differences. Also, many previous studies reported that females are less susceptible to COVID-19 due to lower expression of surface ACE-2 receptors for the virus. The average age of positive subjects was 47.96 ± 14.97 indicating that the SARS-CoV-2 virus mainly affected people

in their 50s. Cases were found to have lower haemoglobin as compared to controls which is similar to the findings of previous studies. However, this association was not statistically significant in this study (p value = 0.278). Lower haemoglobin finding in subjects may be the result of the action of the virus against the development of RBCs or due to its degradation. A study done by Thomas et al. showed that RBCs of COVID-19-positive cases showed decreased levels of antioxidants and enzymes, and increased degradation of proteins.¹³ The present study showed a significant difference in WBC and neutrophil counts.

Among the inflammatory markers, serum creatinine was significantly raised among COVID-19-positive cases. Creatinine is an inflammatory marker; its elevation may be associated with the severity of the disease. Other studies

also demonstrated its elevation in severely ill COVID-19 patients.^{14,15} Also, the COVID-19 cases were found to have higher values for C-reactive protein and procalcitonin as compared to negative cases which is similar to the findings of a study done by Huang et al.¹⁶ Raised procalcitonin and C-reactive protein have been found to be linked up with poor prognosis in COVID-19 and superimposed co-infections.

The prevalence of anaemia was elevated in covid positive cases by a factor of 1.35 in comparison to the negative subjects, respectively, at 53.8% and 46.2%. Thrombocytopenia was significantly higher in cases (65.3%) as compared to the controls (34.7%). In previous studies, low lymphocyte count had been noticed in COVID-positive patients.^{17,18} Furthermore, leucopenia was significantly higher by a factor of 1.79. Leucopenia was also been reported in the study done by Naoum et al.¹⁹ In many studies done on COVID-19 patients, thrombocytopenia and leucopenia had been postulated as indicators of disease severity.^{18,19}

Limitations of the Study

The study has been done at a single centre so generalisation of the results of the study is limited. Also, as it is a retrospective study, so limited information regarding patients could be collected from record data.

Conclusion

To conclude, the present study highlighted various haematological and biochemical parameters of COVID-19 cases. Thrombocytopenia, leucopenia along with raised serum bilirubin, creatinine, ALT, AST, CRP and procalcitonin may be beneficial in the diagnosis of COVID-19. Meticulous assessment and correlation of haematological and biochemical parameters at the time of admission and simultaneously during the disease course will be helpful to physicians in formulating individualised treatment along with decision-making regarding requiring intensive care to those in need.

Authors' Contribution: AO, conceptualise and collected the data for the study. SS has done analysis and interpretation of collected data. SKY has reviewed and edited the article. KY, corresponding author in the study has drafted the article and also critically revised the article. SC played a substantial role in statistical part of the study. KLM has created tables of the data and played substantial role in final editing of the manuscript.

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