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Original Research Paper

Pathology

# PATTERNS OF COMPLETE BLOOD COUNTS (CBC) IN PATIENTS WITH COVID-19 INFECTION

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## ABSTRACT

**Background:** COVID-19 is an ongoing pandemic caused by virus SARS-CoV-2. Many studies worldwide have documented hematological alterations in COVID-19. The present study also aimed to assess the CBC parameters in COVID-19 patients.

**Material And Methods:** It was an observational study conducted in the Department of Pathology, Govt. Medical College, Jammu. COVID-19 patients admitted in the hospital were included in the study. Demographic details and clinical status were noted. EDTA anticoagulated blood samples received were processed on automated 5-part hematology analyzer for CBC. Various parameters obtained were evaluated and also compared with clinical severity of the patients. Results were tabulated and analysed statistically.

**Results:** The study included 304 hospitalized COVID-19 patients. Males were 219 (72%) and females were 85 (28%). Median age of patients was 55 years. Mean hemoglobin concentration was 12.05 g/dl (SD-1.93), mean RBC count was $4.21x10^6/\mu L$ (SD-0.69). Mean WBC count was $9.66x10^3/\mu L$ (SD-4.80), mean absolute neutrophil count was $7.87x10^3/\mu L$ (SD-4.63), mean absolute lymphocyte count was $1.22x10^3/\mu L$ (SD-0.77), mean absolute monocyte count was $0.52x10^3/\mu L$ (SD-0.29), mean absolute eosinophil count was $0.04\ x10^3/\mu L$(SD-0.10). Mean NLR was 10.03 (SD-12.27), mean LMR was 2.84 (SD-2.02), mean PLR was 220.16 (SD-208.46). Mean platelet count was $187x10^3/\mu L$ (SD-97.78). Patients with severe disease show significantly raised WBC count and absolute neutrophil count, significantly decreased absolute lymphocyte count, significantly higher eosinophil count, NLR, PLR and significantly decreased LMR with no significant difference in absolute monocyte count and platelet count.

**Conclusion:** Routine monitoring of CBC parameters in COVID – 19 patients during the course of illness is a simple, rapid means to assess disease severity and progression in these patients.

**KEYWORDS :** Complete Blood Counts (CBC), COVID-19, Hematology

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a newly discovered coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] Since its emergence in Dec. 2019, the disease has rapidly spread worldwide leading to an ongoing pandemic. COVID-19 may present with mild, moderate, or severe illness; the latter includes severe pneumonia, ARDS, sepsis and septic shock, multiorgan failure. Most people develop a mild, uncomplicated respiratory illness with non specific symptoms such as fever, cough, sore throat, nasal congestion, malaise, headache.[2-4]

Diagnosis is confirmed by reverse-transcription polymerase chain reaction (RTPCR) test. Other laboratory and radiological investigations also are a part of routine workup during the course of illness in these patients.[5] Complete blood count (CBC) is a routinely performed hematological investigation. Total leucocyte count(TLC) and derived parameters like Neutrophil lymphocyte ratio (NLR), Lymphocyte Monocyte ratio (LMR) and Platelet Lymphocyte ratio (PLR) are measures of systemic inflammatory response and have been proposed as markers to assist in the diagnosis, early warning, and risk stratification of infectious diseases.[5-7]

Many studies from China and other parts of the world have shown alterations in these hematological parameters associated with COVID-19 infection and have shown prognostic value of many of these parameters in predicting the disease severity in these patients.[2,8-13] However, few studies from India are available in this context. The present study was thus planned with the aim to assess the CBC parameters in COVID-19 patients in the Indian population.

### Material & Methods

It was an observational study conducted in the Department of Pathology, Govt. Medical College, Jammu w.e.f. Sept. 2020 to Jan. 2021. All laboratory confirmed COVID-19 patients admitted to GMC and associated hospitals were included in the study. The patients included had clinically moderate to severe disease based on revised guidelines issued by the Ministry of Health and Family Welfare, Government of India.[4] The study was approved by Institute's Ethics Committee (IEC).

Demographic details and clinical status of these patients were noted. Venous blood samples from these patients collected in EDTA anticoagulant tubes were received in the hematology laboratory for routine Complete Blood Count(CBC) test. These samples were run on automated 5-part hematology analyzer. Various CBC parameters obtained were evaluated. The interpretation was done as per the international standards.[14] Derived ratios were also calculated. These parameters were also compared with the clinical severity of the patients.

Results were presented as percentages for qualitative data and as mean and standard deviation (SD), median for continuous variables along with range values. The CBC parameters (mean) of patients with moderate disease were compared with that of patients with severe disease by unpaired t-test. A P-value of $< 0.05$ was considered statistically significant.

## RESULTS:

A total of 304 patients' samples were received. Male patients were 219 (72%) and female patients were 85 (28%) with male:female ratio of 2.6:1. Median age of patients was 55 years.

The CBC parameters of these patients were analysed as shown in Table 1. Anemia was present in 130 males (Hb < 13 g/dl) and 62 females (Hb < 12 g/dl).

Leucocytosis was seen in 93(30.6%) and leucopenia in 23(7.6%) patients. Absolute neutrophil count was raised (neutrophilia) in 155(51%), decreased in 11(3.6%) patients; lymphocytosis seen in 1(0.3%), lymphopenia in 94(31%)

patients; monocytosis in 13(4.3%), monocytopenia in 5(1.6%) patients; eosinophilia seen in 1(0.3%) and eosinopenia in 149(49%) patients.

**Table 1: CBC Parameters In COVID-19 Patients**

| CBC parameter | Mean | SD | Median | Range |
|---|---|---|---|---|
| Red Blood Cell(RBC) Count (x10$^6$/$\mu$L) | 4.21 | 0.69 | 4.25 | 1.8-6.44 |
| Hemoglobin(Hb) (g/dL) | 12.05 | 1.93 | 12.1 | 6.7-16.9 |
| White Blood Cell(WBC) Count (x10$^3$/$\mu$L) | 9.66 | 4.80 | 8.89 | 0.91-31.65 |
| Absolute Neutrophil Count(ANC) (x10$^3$/$\mu$L) | 7.87 | 4.63 | 7.04 | 0.58-29.06 |
| Absolute Lymphocyte Count(ALC) (x10$^3$/$\mu$L) | 1.22 | 0.77 | 1.07 | 0.17-4.3 |
| Absolute Monocyte Count(AMC) (x10$^3$/$\mu$L) | 0.52 | 0.29 | 0.47 | 0.07-1.58 |
| Absolute Eosinophil Count(AEC) (x10$^3$/$\mu$L) | 0.04 | 0.10 | 0.02 | 0-1.62 |
| Absolute Basophil Count (x10$^3$/$\mu$L) | 0.01 | 0.01 | 0.01 | 0-0.06 |
| NLR | 10.03 | 12.27 | 6.56 | 0.75-121 |
| LMR | 2.84 | 2.02 | 2.35 | 0.3-13.78 |
| PLR | 220.16 | 208.46 | 167.35 | 4.39-1688.23 |
| Platelet Count (x10$^3$/$\mu$L) | 187 | 97.78 | 164 | 12,000-575 |

Among the derived ratios, NLR was raised (>3.1)[5,11] in 243(80%); LMR was decreased(<2.1)[5,13]in 134(44%) patients. Thrombocytopenia (<1.5 lac/cumm) was seen in 126(41.4 %), thrombocytosis (>4.5 lac/cumm) in 7(2.3%) patients while platelet counts were normal in 171(56.3%) patients. Platelet count <1lac/cumm seen in 41(13.5%) patients.

About 247 patients had moderate disease and 57 patients had severe disease. The CBC parameters in patients with moderate disease are as shown in Table 2. Leucocytosis was seen in 64(25.9%), leucopenia in 23(9.3%); neutrophilia in 110 (44.5%), neutropenia in 10(4%), neutrophilic leucocytosis in 64(25.9%); lymphopenia in 68 (27.5%); monocytosis in 10(4%), monocytopenia in 3(1.2%); eosinopenia in 124(50.2%) patients. NLR was increased in 195(78.94%), LMR < 2.1 in 97(39.3%) patients. Thrombocytopenia was seen in 102(41.3%) and thrombocytosis in 8(3.2%) patients.

**Table 2: CBC Parameters In COVID-19 Patients With Moderate Disease**

| CBC parameter | Mean | SD | Median | Range |
|---|---|---|---|---|
| RBC (x10$^6$/$\mu$L) | 4.25 | 0.67 | 4.28 | 2.1–6.44 |
| Hb (g/dL) | 12.2 | 1.9 | 12.3 | 6.7–16.9 |
| WBC/TLC (x10$^3$/$\mu$L) | 9.03 | 4.4 | 8.42 | 0.91–30.16 |
| ANC (x10$^3$/$\mu$L) | 7.2 | 4.11 | 6.56 | 0.58–27.08 |
| ALC (x10$^3$/$\mu$L) | 1.27 | 0.78 | 1.1 | 0.17–4.3 |
| AMC (x10$^3$/$\mu$L) | 0.51 | 0.30 | 0.45 | 0.07–1.58 |
| AEC (x10$^3$/$\mu$L) | 0.03 | 0.04 | 0.01 | 0–0.26 |
| NLR | 8.05 | 8.18 | 5.37 | 0.75–64.23 |
| LMR | 3.07 | 2.11 | 2.57 | 0.56–13.78 |
| PLR | 204.23 | 181.15 | 166.67 | 24.52–1688.23 |
| Platelet count (x10$^3$/$\mu$L) | 190 | 99 | 167 | 36,000–575 |

The CBC parameters in patients with severe disease are as shown in Table 3. Leucocytosis was seen in 29(51%), neutrophilia in 45(79%), neutropenia in 1(2%) and neutrophilic leucocytosis in 29(51%); lymphopenia in 26 (45.6%), monocytosis in 3(5%), eosinopenia in 24(42%) eosinophilia in 1(1.75%), raised NLR in 52(91%), decreased LMR(<2.1) in 37(65%), thrombocytopenia in 24(42%) and thrombocytosis in 1(1.75%) patients.

**Table 3: CBC Parameters In COVID-19 Patients With Severe Disease**

| CBC parameter | Mean | SD | Median | Range |
|---|---|---|---|---|
| RBC (x10$^6$/$\mu$L) | 4.04 | 0.75 | 4.05 | 1.8–5.49 |
| Hb (g/dL) | 11.39 | 1.94 | 11 | 7.1–16.6 |
| WBC (x10$^3$/$\mu$L) | 12.39 | 5.52 | 10.61 | 4.27–31.65 |
| ANC (x10$^3$/$\mu$L) | 10.75 | 5.62 | 8.4 | 1.63–29.06 |
| ALC (x10$^3$/$\mu$L) | 0.99 | 0.67 | 0.75 | 0.19–2.87 |
| AMC (x10$^3$/$\mu$L) | 0.56 | 0.25 | 0.49 | 0.15–1.39 |
| AEC (x10$^3$/$\mu$L) | 0.08 | 0.22 | 0.01 | 0–1.62 |
| NLR | 19.14 | 21 | 11.09 | 1.27–121 |
| LMR | 1.84 | 1.13 | 1.48 | 0.3–5.29 |
| PLR | 289.16 | 291.57 | 157.69 | 4.39–1395.83 |
| Platelet count (x10$^3$/$\mu$L) | 176.49 | 88.54 | 146 | 12-514 |

The CBC parameters of patients with moderate disease were compared with parameters of patients with severe disease. Mean leucocyte count, mean absolute neutrophil count were significantly raised (P <0.0001), mean absolute lymphocyte count significantly decreased (P=0.011) and mean absolute eosinophil count was significantly higher (P=0.0005) in severe disease than moderate disease. However, mean absolute monocyte count and mean absolute basophil count show no statistically significant difference between moderate and severe disease (P=0.26, P=0.96). Among the derived ratios, mean NLR and mean PLR were significantly higher (P <0.0001, P=0.005) and mean LMR was significantly decreased in severe disease (P <0.0001).

Mean hemoglobin shows a statistically significant difference (decreasing trend) (P=0.004), mean RBC count shows marginally significant difference(P=0.04) between moderate and severe disease. Mean platelet count shows no significant difference between moderate and severe disease (P=0.34).

## DISCUSSION:

COVID-19 primarily manifests as a respiratory tract infection, however, is regarded as a systemic disease involving multiple systems including cardiovascular, respiratory, gastrointestinal, neurological, hematopoietic and immune system.[15] Interaction of SARS-CoV-2 with immune system and subsequent dysfunctional immune responses with hyperinflammation are associated with disease progression.[4]

Blood samples from a total of 304 COVID-19 patients were analysed for complete blood counts in the present study. Majority patients were males similar to studies by Nath et al[5] and Anegundi et al.[16] Median age of patients was 55 years similar to study by Liao et al.[2]

Mean RBC count (4.21x10$^6$/$\mu$L,SD=0.69) is within normal limits, comparable to studies by Anegundi et al.[16] and Nath et al;[17] Mean hemoglobin concentration was 12.05 g/dl (SD=1.93), comparable to study by Nath et al.[17]

Mean Total leucocyte count (TLC) was 9.66x10$^3$/$\mu$L (SD- 4.80), median was 8.89x10$^3$/$\mu$L, was within normal limits similar to studies by Anegundi et al.[16] and Nath et al.[17] Leucocytosis was seen in 93(30.6%) patients and leucopenia in 23(7.6%) patients. 13.9%(47/338) patients showed leucocytosis in study by Anegundi et al.[16]In a study by Fan et al,[9] leucopenia was observed in 19 patients(29.2%).

Mean Absolute Neutrophil Count (ANC) was 7.87 x$10^3/\mu$L(SD-4.63) (higher), median was 7.04 x$10^3/\mu$L in the present study. High ANC was seen in 155 (51%) patients. Mean, median ANC were normal in previous studies.[2,16,17]Mean lymphocyte count in our study was 1.22 x$10^3/\mu$L (SD-0.77), median 1.07 x$10^3/\mu$L, is within normal limits similar to studies by Liao et al[2], Anegundi et al.[16] Lymphopenia was seen in 94 (31%) patients in our study. Low ALC(<1,000/cmm) was observed in 19(5.62%) patients in study by Anegundi et al.[16] COVID-19 associated lymphopenia has been proposed to be due to lymphocyte exit from blood circulation to infiltrate pulmonary tissue, direct lysis of virus infected cells, cytokine induced lymphocyte apoptosis and cytokine activation associated atrophy of lymphoid organs impairing lymphocyte turnover.[15,17]

Mean monocyte count was 0.52 x$10^3/\mu$L(SD-0.29), median 0.47 x$10^3/\mu$L, is within normal limits, comparable to studies by Liao et al[2] and Nath et al.[17]Mean eosinophil count in our study was 0.04 x$10^3/\mu$L (SD-0.10), median 0.02 x$10^3/\mu$L, is within normal limits, comparable to study by Liao et al.[2] However, low eosinophil count was seen in 149 (49%) patients in our study. Eosinopenia was observed in 129(38.1%) patients in study by Anegundi et al.[16] Mean basophil count was 0.01 x$10^3/\mu$L, median 0.01 x$10^3/\mu$L, is within normal limits, similar to study by Liao et al.[2]

Mean platelet count was 187 x$10^3/\mu$L (SD-97.78), median 164 x$10^3/\mu$L in our study, is within normal range comparable to studies.[2,16,17]Platelet count <100 x $10^9$ cells/L was observed in 71/380 (19%)[2] while in our study platelet count < 1 lac/cumm was seen in 41 (13.5%) patients. Mean NLR was 10.03(SD-12.27), median 6.56, was higher in our study. It was normal in previous studies.[16,17]LMR >2.1(cut-off) (mean 2.84, median 2.35) in present study is comparable to study by Nath et al.[17]

Statistically significant differences were seen for white blood cell counts, absolute neutrophil count, absolute lymphocyte count, absolute eosinophil count and for derived ratios i.e. NLR, LMR and PLR; hemoglobin and RBC count between patients with moderate and severe disease in our study. The findings were comparable to previous studies.[2,18,19]

Thus, the present study on 304 hospitalized COVID-19 patients shows overall mean RBC count and mean WBC count within normal range, raised mean absolute neutrophil count (neutrophilia), normal mean absolute lymphocyte count, mean monocyte count and mean eosinophil count, raised mean NLR, normal mean LMR and normal mean platelet count. Patients with severe disease show significantly raised WBC count and absolute neutrophil count, significantly decreased absolute lymphocyte count, significantly higher eosinophil count, significantly higher NLR, PLR and significantly decreased LMR with no significant difference in absolute monocyte count and platelet count.

## CONCLUSION:

Routine monitoring of CBC parameters in COVID – 19 patients during the course of illness is a simple, rapid means to assess disease severity and progression in these patients.

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