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Comparing Absolute Eosinophil and Monocyte Counts in Critical and Non-Critical COVID-19 Patients

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ABSTRACT

Emerging evidence suggests that variations in immune cell counts, particularly absolute eosinophil and monocyte counts may be important in predicting the clinical course and severity of the disease in COVID-19 patients. **Objective:** To compare the absolute eosinophil and monocyte counts 'between critical and non-critical COVID-19 patients to elucidate potential associations with disease severity and prognosis. **Methods:** Between March 19th and June 6th, 2021, peripheral blood samples were taken from 26 'critical COVID-19 patients and 26 non-critical COVID-19 patients. Standard laboratory procedures were used to determine the immunological and haematological parameters for every participant. Whole blood samples were taken in ethylenediaminetetraacetic acid (EDTA) tubes and processed per the manufacturer's instructions using an automated haematology analyser (XN-1000, Sysmex, Japan). **Results:** Critical patients of COVID-19 exhibited significantly reduced absolute eosinophil, absolute monocyte, and lymphocyte count compared to non-critical patients. Additionally, critical patients were significantly older. However, there is no significant differences in the two groups' basophil counts, neutrophil counts, WBC counts, RBC counts, HCT percentage, HGB levels, MCH levels, MCV, MCHC levels, and MPV or platelet counts. **Conclusions:** Critical patients exhibited significantly reduced absolute eosinophil and monocyte counts suggesting a potentially weaker immune response in these subgroups. The significance of immune cell counts in assessing the severity of COVID-19 is highlighted by these results which may aid in developing targeted therapeutic interventions and prognostic indicators. Validating these results and clarifying their therapeutic significance will require more investigation.

INTRODUCTION

The COVID-19 pandemic, which has been attributed to the new coronavirus SARS-CoV-2, has posed challenges to healthcare systems worldwide [1]. Mild to severe dyspnoea and multi-system organ failure are the clinical manifestation of this viral respiratory illness [2]. those patients who were medically compromised or had advanced age were more prone to develop critical illness i.e. 'acute respiratory distress syndrome' (ARDS), cytokine storm, and 'systemic inflammatory response syndrome' (SIRS) which often necessitated 'intensive care unit (ICU) admission and mechanical ventilation' [3]. The severity and outcome of COVID-19 are determined in part by immunologic and hematologic variables [4]. These factors include numerous immune cells and inflammatory cells reflecting the immunity of host to viral infection following the inflammatory cascade [5, 6]. The 'absolute eosinophil count, absolute monocyte count, and absolute lymphocyte count' are important cells due to their significant role in modifying immunological responses and fighting viral infections [7]. Many investigations highlighted the importance of these factors in evaluating 'severity and prognosis of COVID-19' [8, 9]. Research conducted by Yang *et al.*, showed significantly lower absolute lymphocyte counts in 'critical COVID-19 patients as compared to non-

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critical patients' which suggested lymphopenia as an important prognostic indicator [1, 10]. Similarly, a study conducted by Qin C *et al.*, observed lower absolute monocyte counts in critical COVID-19 patients, indicating a possible link between monocyte impairment and severity of disease [10]. However, there are lack of studies on comparing the immunologic and hematologic factors of 'critical and non-critical COVID-19 patients' [11, 12]. By understanding the immunologic and hematologic factors linked with COVID-19 severity is important for revealing the primary mechanisms underlying severe COVID-19 and for recognizing therapies prognosis of disease.

This study aimed to distinguish the immunologic and hematologic factors between critical and non-critical COVID-19 patients by evaluating 'absolute eosinophil count', 'absolute monocyte count', and 'absolute lymphocyte count', along with other relevant factors.

METHODS

The study was conducted at two prominent hospitals in Peshawar, Rehman Medical Institute and Hayatabad Medical Complex between March 19th and June 6th, 2021. It was a prospective, cross-sectional observational study. The study enrolled a total of 52 participants, comprising 26 'critical patients and 26 non-critical patients', all diagnosed with COVID-19. The sample size was calculated by using mean ± SD of CD4/CD8. OpenEpi, Version 3, was used with 95% of Confidence Interval and Power of 80%, using values 2.24 ± 0.93 for non-critically ill and 3.38 ± 1.83 for critically ill people from Pallotto *et al* [12, 13]. The participants were carefully matched for age and gender distribution. Patients who were not very sick got outpatient care at the pulmonology clinic, whereas critical patients were admitted to isolation rooms or the intensive care unit. Exclusion criteria for participation in the study included individuals with pre-existing chronic conditions requiringe immunosuppressive therapy, active viral, autoimmune, or oncological diseases, and those who had received steroid treatment prior to blood sample collection. Upon obtaining informed written consent, demographic and clinical information was systematically recorded using a specifically designed questionnaire. Three milliliters of vein blood were drawn from every individual. and subjected to analysis for immunological and hematological parameters using a fully automated hematology analyzer (XN-1000, Sysmex, Japan). The analysis adhered to established guidelines for laboratory testing of suspected COVID-19 cases. The approval of this study was taken from the Institutional Research Ethical Board of IBMS KMU Peshawar with the reference no. KMU/IBMS/IRBE/10th Meeting/2024/1753-H. The statistical software SPSS Version 23.0 was utilized for data analysis, and descriptive statistics were employed to obtain the mean and standard deviation of numerical variables. The threshold for statistical significance was fixed at $p < 0.05$. The study findings were meticulously presented through tables, charts and graphs.

RESULTS

Critical patients were significantly older compared to non-critical patients (57.85 ± 11.66 versus 44.15 ± 14.74, p = 0.001). Critical patients had significantly reduced absolute monocyte counts compared to non- critical patients (0.36 ± 0.23 vs 0.63 ± 0.31, p = 0.01). Absolute basophil numbers did not significantly differ between critical and non-critical COVID-19 patients (p = 0.65; 0.02 ± 0.01 versus 0.01 ± 0.01). Absolute lymphocyte counts were substantially higher in non-critical patients (1.85 ± 0.97 versus 1.12 ± 0.74, p = 0.004) than in critical patients. Absolute neutrophil counts did not significantly differ between patients classified as critical and non-critical (6.24 ± 4.11 versus 8.17 ± 4.46, p = 0.112). Absolute white blood cell (WBC) counts did not significantly differ between patients classified as critical and non-critical (8.54 ± 3.83 versus 9.72 ± 4.57, p = 0.315). Between critical and non-critical patients, there was no statistically significant difference in absolute red blood cell (RBC) counts (4.90 ± 0.86 versus 4.99 ± 0.66, p = 0.681). Hematocrit (HCT) levels did not significantly differ between patients classified as critical and non-critical (42.27 ± 8.68 versus 44.09 ± 8.03, p = 0.436). Haemoglobin (HGB) levels did not significantly differ between patients classified as critical and non-critical (13.10 ± 2.12 versus 13.32 ± 1.83, p = 0.686). Between critical and non-critical patients, there were no appreciable variations in 'mean corpuscular haemoglobin' (MCH), 'mean corpuscular haemoglobin concentration' (MCHC), 'mean corpuscular volume' (MCV), or 'mean platelet volume' (MPV) (p > 0.05). Between patients classified as critical and non-critical, there was no statistically significant difference in platelet counts (268.73 ± 88.83 versus 243.15 ± 100.79, p = 0.336) (Table 1).

Table 1: Comparison of Immunological and Hematological Parameters between Critical and Non-Critical COVID Patients

Variables	Non-Critical Patients Mean ± SD	Critical Patients Mean ± SD	p-Value
Age (Years)	44.15 ± 14.74	57.85 ± 11.66	0.001
Absolute Basophil Count	0.02 ± 0.01	0.01 ± 0.01	0.65
Absolute Eosinophil Count	0.99 ± 0.13	0.09 ± 0.02	0.01
Absolute Lymphocyte Count	1.85 ± 0.97	1.12 ± 0.74	0.004
Absolute Monocytes Count	0.63 ± 0.31	0.36 ± 0.23	0.01
Absolute Neutrophil Count	6.24 ± 4.11	8.17 ± 4.46	0.112
Absolute WBC Count	8.54 ± 3.83	9.72 ± 4.57	0.315
Absolute RBC Count	4.90 ± 0.86	4.99 ± 0.66	0.681
HCT%	42.27 ± 8.68	44.09 ± 8.03	0.436
HGB (g/dL)	13.10 ± 2.12	13.32 ± 1.83	0.686
MCH (pg)	26.96 ± 3.33	26.97 ± 2.543	0.996
MCHC (g/dL)	31.55 ± 5.08	0.15 ± 3.07	0.233
MCV (fL)	86.07 ± 8.16	89.70 ± 7.79	0.107
MPV (fL)	11.87 ± 1.06	11.72 ± 0.87	0.579
Platelets Count	268.73 ± 88.83	243.15 ± 100.79	0.336

Note: P values ≤ 0.05 are considered significant

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Figure 1 shows the comparison of absolute monocyte and eosinophil counts between critical and non-critical COVID-19 patients. Critical patients exhibited significantly lower counts of both monocytes and eosinophils compared to non-critical patients. The data highlights the potential association between reduced immune cell counts and disease severity. Critical patients had significantly reduced absolute eosinophil counts compared to non-critical patients (0.09 ± 0.02 vs 0.99 ± 0.13 p = 0.01)(Figure 1).

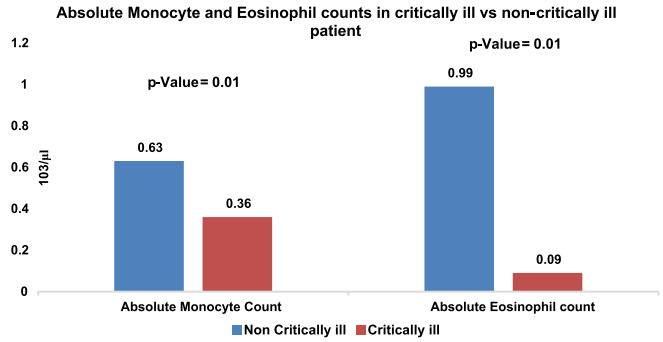

Figure 1: The Absolute Counts of Monocytes and Eosinophils in Critical Versus Non-Critical Patients

DISCUSSION

In the present investigation we found that critical patients were significantly older compared to non-critical patients (57.85 ± 11.66 versus 44.15 ± 14.74, p = 0.001). 'A retrospective study carried out by Tian R *et al.*, in 2020 from China also found that elderly patients were more serious when comparing to young patients [13]. A multicenter study conducted by another author from Egypt also found that older age critical patients were more effected [14]. In our study critical patients had significantly reduced absolute monocyte counts compared to non- critical patients (0.36 ± 0.23 vs 0.63 ± 0.31, p = 0.01). A study by Chinese researchers Zhang D *et al.*, in 2020 also discovered a decreased monocyte count in seriously ill COVID-19 patients [14]. In line with our findings, Shuang Qin *et al.*, in 2020 study discovered lower monocyte numbers in critically sick COVID-19 patients [15]. Our results revealed that the eosinophils count and critical and non-critical COVID 19 patients were significantly associated. A study conducted by Liu *et al.*, found the association between reduced eosinophils count and the severity of disease in COVID-19 patients. It was found that critical patients had more reduced eosinophil count than non-critical patients [16]. An investigation carried by researcher examined the immunologic features of reduced eosinophils in patients infected with COVID-19. They found that eosinophil reduction was associated with impaired T-cell responses and increased production of inflammatory cytokines which led to the formation of severe respiratory complications and systemic inflammation [17]. Additionally, eosinophil count in COVID-19 was evaluated in a systematic review conducted by Senthilnayagam B *et al.*, for its diagnostic and prognostic efficacy. This study showed the clinical importance of reduced eosinophils as a possible indicator of illness severity and mortality [18, 19]. Our investigation shows that Absolute lymphocyte counts were substantially higher in non-critical patients (1.85 ± 0.97 versus 1.12 ± 0.74, p = 0.004) than in critical patients. This study's findings contradicted to those of Javadi A *et al.*, in 2021, who discovered that severely ill patients had higher lymphocyte counts. In our study findings absolute neutrophil counts, absolute 'white blood cell' counts, 'red blood cell' counts, 'Hematocrit' levels Hemoglobin 'mean corpuscular hemoglobin', 'mean corpuscular hemoglobin concentration', 'mean corpuscular volume', or 'mean platelet volume' did not significantly differ between patients classified as critical and non-critical. Our results are consistent with the study carried out in 2021 by Javadi A *et al* [20].

CONCLUSIONS

In conclusion, the present investigation showed the association of immunologic and hematologic factors in COVID-19 by relating 'critical and non-critical patients. The analysis of absolute eosinophil count, absolute monocyte counts along with other relevant markers led us to their association with disease severity and clinical outcomes. By illuminating these associations, our results help in diagnosis, informing treatment plan and the developing targeted therapies to improve patient outcomes against COVID-19.

Authors Contribution

Conceptualization: YI,
Methodology: MOM, AM, YI
Formal analysis: YMY
Writing, review and editing: MQ, IK, YI

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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