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RESEARCH ARTICLE

Complete Blood Picture Profile of Covid-19 Patients Admitted in a Tertiary Care Hospital, Dhaka, Bangladesh

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Abstract

Context: COVID-19 is the pandemic disease causes severe acute respiratory infection. T-cell mediated responses are activated and responses are initiated by antigen presentation via DCs and macrophages. Immunologically SARS-CoV showed that virus infected lung epithelial cells produced IL-8 in addition to IL-6. A hyperinflammatory environment has been a hallmark of COVID-19 infection and is thought to be a key mediator of morbidity and mortality. In most cases the clinical presentation is that of a respiratory infection with a symptom severity ranging from a mild influenza like illness, to a severe viral pneumonia leading to acute respiratory distress syndrome that is potentially fatal.

Methods: This study was a cross-sectional observational study, conducted in Department of Medicine, Shaheed Suhrawardy Medical College Hospital. Patients with COVID-19 positive were enrolled after fulfilling the inclusion and exclusion criteria. Samples were selected by purposive sampling technique. Sample size was 200. Detail socio-demographic data were collected from the informant and recorded in structured case report form. Clinical examination and relevant investigation were done.

Result: Present study demonstrates that maximum number of patients (43.0%) were between 41-50 years age group. Mean age of the patient was 42.35 ± 11.7 years. Out of 200 cases 78% were male and 22% were female. Male and female ratio was 3.54:1. Socioeconomically poor class 42% comprising the major percentage of the patients, and 68.0% patients came from urban area and 32.0% from rural area. In this study fever and cough was commonest presentation, 79.0% & 36.0% of patients respectively. Other manifestations were headache (16.0%), diarrhea (20.0%), tachycardia in (29.0%) and fast breathing in 21.0% of patients. Clinical characteristics revealed that mild were 44.0% patients, moderate disease was 37.0% patients, and

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severe to critical was 19.0% of patients. On evaluation of complete blood count report, hemoglobin level was depleted in 17.0% patients, leukocytosis was observed in 39.0% patients and decreased platelet count (thrombocytopenia) in 58.0% patients with mean value 137.2±24.5×10^9/l. Increased neutrophils count (neutrophilia) and decreased lymphocytes count (lymphocytopenia) was predominant findings, with mean value 7.9±1.3×10^9/l and 1.3±0.8×10^9/l respectively. Present study shows that thrombocytopenia and leukocytosis was significantly associated with severity of COVID-19. In severe to critical illness, maximum patients were detected thrombocytopenia (94.7%). Similarly maximum patients were detected leukocytosis was detected in 78.9% patients. The result was significant ($p<0.05$). So thrombocytopenia and leukocytosis are predictor of severity of COVID-19.

Conclusions: Several haematological parameters, such as platelets, white blood cell total count, lymphocytes, neutrophils and haemoglobin were described to be associated with COVID-19 infection and severity. Present study concluded that decreased platelet, lymphocyte, haemoglobin, eosinophil, and basophil count, increased neutrophil count and neutrophil-lymphocyte ratio have been associated with COVID-19 infection and a worse clinical outcome.

Keywords: Blood Picture Profile, Of Covid-19, Lymphocytes, Neutrophils.

1. Introduction

Coronavirus has caused a pandemic since it was first detected in Wuhan in December 2019. The mortality rate is high in moderate and severe cases. Genetic sequencing of the virus suggests that it is a beta-coronavirus closely linked to the SARS virus. By way of definition, a symptomatic COVID-19 case is a person who has developed signs and symptoms suggestive of COVID-19[1]. Bangladesh is also facing the toll of this highly transmissible zoonotic disease with community transmission (at different rate) across the country. The clinical syndrome ranges from mild illness, pneumonia, severe pneumonia, ARDS, sepsis, septic shock and multiorgan failure[2]. The main features described are pulmonary manifestations; however, this systemic infection seems to have a direct impact on the hematopoietic system[3]. Early recognition and rapid diagnosis are essential to prevent transmission and provide appropriate care in time frame. Coronaviruses are enveloped, positive-sense, single-stranded RNA viruses of ~30 kb. They infect a wide variety of host species. They are largely divided into four genera; α, β, γ, and δ based on their genomic structure. α and β coronaviruses infect only mammals[4]. Human coronaviruses are responsible for common cold and croup and belong to α coronavirus. T-cell mediated immunological reaction is major immune responses in COVID-19 cases. The study of SARS-CoV showed that virus infected lung epithelial cells produced IL-8 in addition to IL-6[4]. Quantitative hematologic abnormalities have been reported since the first appearance of this disease, all blood cells can be affected during COVID-19, mainly leukocyte and platelet cells[5]. IL-8 is a well-known chemoattractant for neutrophils and T cells. Infiltration of a large number of inflammatory cells were observed in the lungs from severe COVID-19 patients, and these cells presumably consist of a constellation of innate immune cells and adaptive immune cells. Severe patients also showed pathological cytotoxic T cells derived from CD4+ T cells[6]. These cytotoxic T cells can kill virus but also contribute to lung injury. Circulating monocytes respond to GM-CSF released by these pathological T cells[4]. In COVID-19 patients, CD14+CD16+ inflammatory monocyte subsets found at significantly higher percentage. In addition to respiratory symptoms, thrombosis and pulmonary embolism have been observed in severe diseases. This is in line with the finding that elevated d-dimer and fibrinogen levels were observed in severe diseases. The function of the endothelium includes promotion of vasodilation, fibrinolysis, and anti-aggregation. Clinical and virologic studies that have collected repeated biological samples from confirmed patients demonstrate that shedding of SARS-CoV-2 is highest in the upper respiratory tract (URT) (nose and throat) early in the course of the disease[7-9], within the first 3 days from onset of symptoms. The incubation period for COVID-19, which is the time between exposure to the virus (becoming infected) and symptom onset, is, on average, 5–6 days, but can be up to 14 days. During this period, also known as the "presymptomatic" period, some infected persons can be contagious, from 1–3 days before symptom onset[10]. It is important to recognize that presymptomatic transmission still requires the virus to be spread via infectious droplets or by direct or indirect contact with bodily fluids from an infected person. An asymptomatic case is a person infected with SARS-CoV-2 who does not develop symptoms. Complete blood picture profile of COVID-19 patient's is important to identifying which

patients will have progressive pneumonia and need more robust treatment. Evaluation of the white blood cell (WBC), neutrophil, lymphocyte, monocyte, eosinophil, and platelet counts, and hemoglobin concentrations are basic parameters to assess the disease condition[11, 12]. Significant numerical and atypical WBC morphologic changes associated with SARS-CoV-2 infection shows that the severity of changes is distinct not only between mild and severe disease but also between critically ill patients with and without COVID-19 infection[13]. The patients who ultimately died of this disease continued to develop neutrophilia. As granulocytes are stimulated by granulocyte colony-stimulating factor, which has been shown to be increased in critically ill COVID-19–positive patients. Most patients with fatal disease also demonstrate progressive lymphopenia[14]. As well as WBC morphologic changes are also different between disease stages in COVID-19–positive patients. So, hematological parameter has important predictive value in COVID-19 patients. Our study aimed was to screen the CBC parameters as a useful predictive factor for COVID-19 resulting in critical illness.

2. Materials and Methods

2.1 Study Design

Cross sectional observational study.

2.2 Place of Study

Department of Medicine, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh.

2.3 Study Periods

Study was conducted over a period of six months, from 4th August 2021 to 3rd February 2022.

2.4 Study Population: Patients aged >18 years of both gender with RT-PCR positive COVID-19 cases admitted at the study place during study period were enrolled for study.

2.5 Sample Size

Sample size is calculated by using following

$$n = \frac{z^2 pq}{d^2}$$

According to this formula the targeted sample is 384. Due to time and resource constrain, 200 samples were taken for analysis and statistical convenience.

2.6 Selection Criteria

2.6.1 Inclusion Criteria

1) Patients aged >18 years of both gender with RT-PCR positive COVID-19 cases admitted at the study place during study period and are willing to participate
2) Patients giving informed consent to take part in this study

2.6.2 Exclusion Criteria

1. Patients with other active infection
2. Patients with active malignancy
3. Chronic diarrhea
4. Not willing to participate.

2.7 Data Collection Procedure

The diagnosis of COVID-19 was confirmed by clinical, radiological and microbiological evidence. COVID-19 diagnosis was based on the WHO interim guidance. A confirmed case of COVID 19 was defined as a positive result on high-throughput sequencing or real-time reverse trascriptase-polymerase-chain reaction (RT-PCR) assay of nasal and pharyngeal swab specimens. Only laboratory confirmed cases included in this study. After fulfilling the inclusion and exclusion criteria, patient were enrolled with unique ID. Subjects briefed about the objectives of the study, risk and benefits, freedom for participating in the study and confidentiality. Informed consent was obtained accordingly.

Detail socio-demographic data, clinical data, e.g., presenting complaints, predisposing factors, examination findings, any co-morbidity, etc. were collected and recorded in structured case report form. Relevant investigation also evaluated. Staging or severity of COVID-19 were graded as follows: (1) mild: mild clinical symptoms, no pneumonia on lung CT; (2) moderate: fever, cough and lung CT with pneumonia; (3) severe: respiratory distress (respiratory rate>30 min−1, oxygen saturation (O_2 Sat) ≤ 93 percent at rest and/or ratio of arterial oxygen partial pressure to fractional inspired oxygen ≤300 mmHg (PaO2/FIO2); and (4) critical: aforementioned criteria of respiratory failure receiving mechanical ventilation, shock, and/or organ failure other than lung and/or intensive care unit (ICU) hospitalization. At least 5ml of venous blood samples were collected for evaluation of the hematological profile and other relevant investigation. Hematological profile were evaluated of all patients including Hb%, WBC, RBC, Platelet count, MCV, MPV, Neutrophil, Lymphocyte, Neutrophil-to-lymphocyte ratio, Monocyte, Eosinophil, Basophil count. Finally co-relation between blood picture and severity of covid-19 diseases were conducted. Data was processed and analysed with the help of computer program SPSS

and Microsoft excel. Quantitative data expressed as mean and standard deviation and qualitative data as frequency and percentage. Comparison was done by tabulation and graphical presentation in the form of tables, pie chart, graphs, bar diagrams, histogram & charts etc.

2.8 Data Analysis

Data were recorded on a predesigned proforma and managed on Microsoft excel spread sheet. Continuous variables were summarized by means and standard deviations. Categorical variables were summarized by percentages. After collection of all information, these data were checked, verified for consistency and edited for finalized result. After editing and coding, the coded data were directly entered into the computer by using SPSS version 22. The result was presented in tables. A "P" value <0.05 is considered as significant.

3. Results

Table 1. *Demographic characteristics of the study population (n=200)*

Age (years)	Number of patients	Percentage (%)
≤30	8	4.0
31-40	48	24.0
41-50	86	43.0
51-60	36	18.0
61-70	22	11.0
Mean ± SD	42.35 ± 11.7	
Sex		
Male	156	78
Female	44	22
Total	200	100
Patients Classes		
Middle Class	76	38
Poor Class	84	42
High Class	40	20
Occupation		
Service holder	32	16.0
Businessman	26	13.0
Retired	96	48.0
House wife	36	18.0
Unemployed, others	10	5.0
Residency		
Urban	136	68
Rural	64	32

Table-1 showed age distribution of patients. Study demonstrates that maximum number of patients (43.0%) were between 41-50 years age group, next (24.0%) were between the age group of 31-40 years. Mean age of the patient was 42.35 ± 11.7 years. Gender distribution of the patients. Out of 200 cases 78% were male and 22% were female. Male and female ratio was 3.54:1. Socioeconomically patients are grouped into three classes. Poor class 42% comprising the major percentage of the patients, which is followed by middle class 38% and remaining are upper class 20%. Occupation status of the patients. Large number of respondents were retired person (48.0%) followed by housewife (18.0%). 68.0% patients came from urban area and 32.0%) from rural area.

Table 2. *Distribution of cases according to clinical manifestation (n=200)*

Clinical manifestation	Frequency	Percentage (%)
Fever	158	79.0
Cough	72	36.0
Dyspnoea	40	20.0
Headache	32	16.0

Diarrhoea	40	20.0
Tachycardia	58	29.0
RR > 30 breaths/min	42	21.0
SpO_2		
> 90%	152	76.0
< 90%	48	24.0
Crepitation over lung	42	21.0
Hypotension	18	9.0

**Multiple respondents*

Table-2 shows the distribution of cases according to clinical manifestation. Fever and cough was commonest presentation, 79.0% &36.0% of patients respectively. Other manifestations were headache (16.0%), diarrhea (20.0%), tachycardia in (29.0%) and fast breathing in 21.0% of patients.

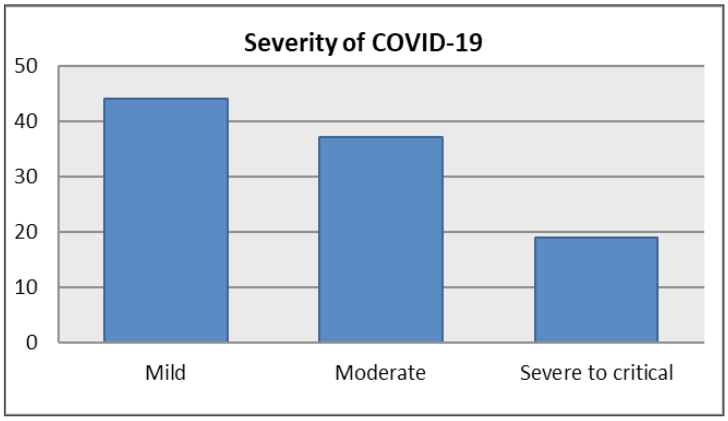

Figure 1. *Clinical characteristics of COVID-19 by severity (n=200)*

On evaluation of clinical characteristics of COVID-19 by severity, symptomatic group with mild were 44.0% patients, moderate disease was 37.0% patients, and severe to critical was 19.0% of patients (fig-1).

Table 3. *Hemoglobin level of study subject (n=200)*

Hb level (g/dl)	Frequency	Percentage	Mean ± SD
≤9.0	8	4.0	12.7±2.6
9.1-11.0	26	13.0	
11.1-15.9	156	78.0	
>16.0	10	5.0	

Table-3 shows the hemoglobin level of study subject. Hemoglobin level was depleted in 17.0% patients. In maximum number of patients (e.g. 78.0%) haemoglobin concentration was 11.1-15.9 g/dl. Mean ± SD was 12.7 ±2.6.

Table 4. *Assessment of Total count of WBC (n=200)*

TC of WBC (10^9/l)	Frequency	Percentage	Mean ± SD
<4.0	16	8.0	
4.0-11.0	106	53.0	15.2±4.1
>11.0	78	39.0	

In this study leukocytosis was observed in 39.0% patients. Total count of WBC was within normal range was 53.0% subject with mean values of TC was 15.2±4.1×10^9/l (table-4).

Table 5. *Assessment of Differential count of WBC (n=200)*

DC of WBC (10^9/l)	Mean	±SD
Neutrophil (×10^9/l)	7.9	±1.3
Range (min-max)	2.7	-8.3
Lymphocytes (×10^9/l)	1.3	±0.8
Range (min-max)	1.0	-3.1

Monocytes (×10⁹/l)	1.2	±0.1
Range (min-max)	0.5	-1.7
Eosinophil (×10⁹/l)	0.2	±0.03
Range (min-max)	0.04	-0.4
Basophil (×10⁹/l)	0.1	±0.01
Range (min-max)	0.04	-0.1

Present study has demonstrated that differential leukocyte count level altered in COVID-19 patients. Increased neutrophils count (neutrophilia) and decreased lymphocytes count (lymphocytopenia) was predominant findings, with mean value 7.9±1.3×10⁹/l and 1.3±0.8×10⁹/l respectively. Monocytes count also increases, esonophil count and basophil count decreases in COVID-19 patients (table-5).

Table 6. *Platelet count of the study subject (n=200)*

Platelets (10⁹/l)	Frequency	Percentage	Mean ± SD
<150	116	58.0	
150-350	84	42.0	137.2±24.5
>350	0	0	

Table-6 shows the platelet count of the study subject. Platelet count was decreased (thrombocytopenia) in maximum patients (e.g., 58.0%) with mean value 137.2±24.5×10⁹/l.

Table 7. *Association of Hb level with severity of COVID-19 (n=200)*

Hb level (g/dl)	Severity of COVID-19			p-value
	Mild (n=88)	Moderate (n=74)	Severe-critical (n=38)	
≤9.0	0	2 (2.7)	6 (15.7)	
9.1-11.0	0	6 (8.1)	20 (52.6)	0.0954
11.1-15.9	86 (97.7)	58 (78.3)	12 (31.5)	
>16.0	2 (2.27)	8 (10.8)	0	

Table-7 shows the association of Hb level with severity of COVID-19. Although low hemoglobin concentration or anemia predominantly found in severe to critical illness, result was non-significant (p>0.05). In severe to critical illness patients 15.7% cases detected anemia, in moderate illness 2,7% cases were anaemia, none of the mild disease detected anemic.

Table 8. *Association of platelet count with severity of COVID-19 (n=200)*

Platelets count (10⁹/l)	Severity of COVID-19			p-value
	Mild (n=88)	Moderate (n=74)	Severe-critical (n=38)	
<150 ×10⁹/l	18 (20.4)	62 (83.7)	36 (94.7)	
150-350 ×10⁹/l	70 (79.5)	12 (16.2)	2 (5.2)	0.0026
>350 ×10⁹/l	0	0	0	

Present study shows that thrombocytopenia was significantly associated with severity of COVID-19. In severe to critical illness, maximum patients were detected thrombocytopenia (94.7%). In mild cases, maximum patients (e.g., 79.5%) had normal platelet count. The result was significant (p<0.05). So, thrombocytopenia is a predictor of severity of COVID-19 (table-8).

Table 9. *Association of WBC count with severity of COVID-19 (n=200)*

TC of WBC (10⁹/l)	Severity of COVID-19			p-value
	Mild (n=88)	Moderate (n=74)	Severe-critical (n=38)	
<4.0	4 (4.5)	12 (16.2)	0	
4.0-11.0	76 (86.3)	22 (29.7)	8 (21.0)	0.0129
>11.0	8 (9.0)	40 (54.0)	30 (78.9)	

Present study shows that leukocytosis was significantly associated with severity of COVID-19. In severe to critical illness, maximum patients were detected leukocytosis (e.g., 78.9%). The result was significant (p<0.05). P-value reached from chi square test. So leukocytosis is a predictor of severity of COVID-19 (table-9).

4. Discussion

This cross-sectional observational study was conducted at Shaheed Suhrawardy Medical College Hospital to observe the complete blood picture profile of covid-19 patients. Patients with COVID-19 positive were enrolled after fulfilling the inclusion and exclusion criteria. Present study demonstrates that maximum number of patients (43.0%) were between 41-50 years age group. Mean age of the patient was 42.35 ± 11.7 years. Out of 100 cases 78% were male and 22% were female. Male and female ratio was 3.54:1. Result of present study was consistent with the results of previous study that mean age was 49.0 years. Predominant responders were male (57.6%)[15]. In this study fever and cough was commonest presentation, 79.0% & 36.0% of patients respectively. Other manifestations were headache (16.0%), diarrhea (20.0%), tachycardia in (29.0%) and fast breathing in 21.0% of patients. Mean heart rate were 86.43 ± 8.34bpm, mean BP was 92.50 ± 28.43 mm of Hg, mean temperature 37.63 ± 1.27ºC, and respiratory rate was 18.23 ± 2.23/m. Study in Bangladesh reported that 154 (77%) patients presented with fever, followed by sore throat (12.5%), myalgia (12.5%), fatigue (7.5%) diarrhoea (3%)[16]. In this study, clinical characteristics of COVID-19 by severity was symptomatic group with mild were 44.0% patients, moderate disease was 37.0% patients, and severe to critical was 19.0% of patients. On evaluation of complete blood count report, hemoglobin level was depleted in 17.0% patients, leukocytosis was observed in 39.0% patients and decreased platelet count (thrombocytopenia) in 58.0% patients with mean value 137.2±24.5×10^9/l. Increased neutrophils count (neutrophilia) and decreased lymphocytes count (lymphocytopenia) was predominant findings, with mean value 7.9±1.3×10^9/l and 1.3±0.8×10^9/l respectively. Present study shows that thrombocytopenia and leukocytosis was significantly associated with severity of COVID-19. In severe to critical illness, maximum patients were detected thrombocytopenia (94.7%). Similarly maximum patients were detected leukocytosis was detected in 78.9% patients. The result was significant ($p<0.05$). So, thrombocytopenia and leukocytosis are predictor of severity of COVID-19. All findings accordance with result of other studies. Previous study noted that several haematological parameters, such as platelets, white blood cell total count, lymphocytes, neutrophils, (together with neutrophil lymphocyte and platelet-lymphocyte ratio), and haemoglobin were described to be associated with COVID-19 infection and severity. Decreased platelet, lymphocyte, haemoglobin, eosinophil, and basophil count, increased neutrophil count and neutrophil-lymphocyte ratio have been associated with COVID-19 infection and a worse clinical outcome[17]. Autoimmune haemolytic anaemia (AIHA) was recently described in COVID-19 patients[18]. Autoimmune haemolytic anaemia causes platelet cell death and RBCs can also modulate platelet activity through either chemical signalling or direct RBC-platelet interactions. Thus, evidence for haemolysis may account for the microvascular coagulation seen in COVID-19 patients[17]. Berzuini et al. reported the observation that about half of patients with COVID-19 tested at their blood center had a positive direct antiglobulin test (DAT). However, eluates did not react with any test cells but did react with red cells from patients with COVID-19 that were DAT negative. This suggests that COVID-19 may modulate the red cell membrane and present novel antigenic epitopes[19]. Patients with COVID-19 present decreased haemoglobin concentration and pathologically increased concentrations of ferritin. Wang et al. reported reduced haemoglobin concentration (< 110 g/L) in 19% of the hospitalized patients[20] while Huang et al. reported reduction in haemoglobin concentrations in 38% of the study population admitted to the hospital[21]. In COVID-19 infection, the presence of thrombocytopenia correlates with the severity of the disease and indicates the presence of a consumption coagulopathy[17]. Lippi et al. correlated a low PLT count with higher mortality and more severe COVID-19 illness[22]. In this study platelet number was found to be lower in patients with more severe illness or poor outcomes.

The mechanism by which the coronavirus interferes with the haematopoietic system is still unclear. Three mechanisms of a cascade can be assumed to explain thrombocytopenia in SARSCoV-2 infections: 1) direct infection of bone marrow cells by the virus with inhibition of PLT synthesis; 2) destruction of PLTs by the immune system; 3) aggregation of PLTs in the lungs with the formation of microthrombi and further consumption of PLTs. Viruses can interact with megakaryocytes and reduce PLT synthesis[23]. It has been assumed that the SARS-CoV-2 inhibits bone marrow haematopoiesis through specific receptors to depress the primary formation of PLTs and resulting thrombocytopenia[24]. The best recognized haematological abnormality in patients affected by COVID-19 infection is lymphopenia, which is seen in up to 85% of severe cases with the severity of lymphopenia linked to outcome[25]. The presence of lymphopenia (defined by an absolute number of lymphocytes < 1.0 x10^9/L) is reported in most of the

published series and is commonly considered to be a deficient immunological response to viral infection[26]. Lymphopenia might be caused by virus attachment or indirectly by immune injuries from inflammatory mediators. Moreover, exudation of circulating lymphocytes into inflammatory lung tissues might also lead to lymphopenia. The reduction of lymphocyte subset count in COVID-19 patients was investigated across 20 peer-reviewed studies for reporting lymphocyte subset counts and COVID-19 disease severity. CD4+ T cell, CD8+ T cell, B cell, Natural killer (NK) cell, and total lymphocyte cell counts all showed a statistically significant reduction in patients with severe/critical COVID-19 disease compared to mild/moderate disease[17]. A minority of patients present leucocytosis, supported by neutrophilia: this finding seems to correlate with a more severe course[27]. As COVID-19 progresses, the number of circulating neutrophils gradually increases; thus, neutrophilia has been identified as a marker of severe respiratory disease and a poor outcome[28]. Leukocytes and neutrophils were significantly higher in severe than in non-severe COVID-19 infected patients. Neutrophils have a crucial role as drivers of hyper-inflammation associated with COVID-19 disease via enhanced degranulation and cytokine production[17].

Mu et al. evidenced a significant eosinopenia in 72/95 SARS-CoV-2 patients ($P < 0.01$). The absolute eosinophil count was 0.01 $x10^9$/L and the eosinophil percentage was 0.3%. Moreover, eosinophil blood count progressively returned to normal together with clinical conditions improvement, while continued to decline for patients without clinical improvement[29]. Neutrophil-lymphocyte ratio is elevated in the bloodstream of COVID-19 infected patients[17]; Zhang et al. reported that NLR combined with IgG might be a better predictor than neutrophil count alone in predicting the severity of COVID-19[30]. Levels of NLR and PLR correlate with COVID-19 disease severity. Patients with severe disease had higher NLR and PLR values compared to non-severe diseases[17]. A case report describes NLR and PLR fluctuation during the progression of COVID-19 disease. From the admission, white blood cells, neutrophils, platelets, and the NLR gradually increased and reached a peak on the 14th day, while the number of lymphocytes did not reach the maximum value, but it showed only an upward trend. The NLR gradually returned to normal after the patient's improvement on the 14th day[31]. White blood cells, neutrophils, platelets, and the NLR have been considered independent factors associated with COVID-19 progression. Those suggest that it is necessary to pay attention to the COVID-19 patients with alteration of hematological value.

5. Conclusions

COVID-19 is global burden which is a potentially severe acute respiratory infection caused by a novel evolving severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In most cases the clinical presentation is that of a fever & respiratory infection with a symptom severity ranging from a mild influenza like illness, to a severe viral pneumonia leading to acute respiratory distress syndrome that is potentially fatal. Coronavirus disease 2019 has prominent manifestations from the hematopoietic system. Several haematological parameters, such as platelets, white blood cell total count, lymphocytes, neutrophils, (together with neutrophil lymphocyte and platelet-lymphocyte ratio), and haemoglobin were described to be associated with COVID-19 infection and severity. Since the severe to critical stage of the disease, not only the platelets and lymphocytes but also haemoglobin, eosinophils, and basophils present a marked decrease, associating with the disease severity and clinical outcome. At the moment, the kinetics of WBC count in COVID-19 infection is still undefined, as SARS-CoV-2 infection of total count, seems to directly impair the anti-viral adaptive immune responses. Finally, an increase of neutrophils and thrombocyopenia correlate with progressive disease. Careful evaluation of laboratory indices at baseline and during the disease course can assist clinicians in formulating a tailored treatment approach and promptly provide intensive care to those who are in greater need.

Recommendations

1) This study has emphasized the importance of laboratory information in the management of COVID-19, further studies are worth describing the association between the dynamic haematological responses and the progression and outcome of the disease

2) Large scale, multi centre study should be conducted.

3) Facilities for prompt and adequate management facilities should be available in all hospitals. Investigation facility is mandatory in primary and secondary level heath care centre.

Limitations of the Study

- Small sample size
- Single center study; only patients admitted in Shaheed Suhrawardy Medical College Hospital were taken for the study. So, this will not reflect

the overall picture of the country. A large-scale study needs to be conducted to reach to a definitive conclusion.

- Sample were taken by purposive method in which question of personal biasness might arise.

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