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Study of hematological parameters in COVID-19 patients in a teaching hospital, Telangana

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***Abstract*---**Background: Coronavirus infectious disease-2019 (COVID-19) have mild to moderate symptoms and recover after the appropriate medical intervention(s). 15–32 percent develop severe or critical COVID-19 with a case-fatality rate of 1–15% . Viral infection is well known to be associated with abnormal haematological parameters. Aim of the study :. To study haematological parameters in covid 19 patients in a teaching hospital, Telangana.Materials & Methods: Prospective and retrospective observational study done for duration of 6 months ie, from November 2020 to April 2021 in the department of Pathology at Prathima institute of medical sciences ,Karimnagar , Telangana. Results: Majority of the cases were noted among 31-40 years constituting 40.4% and followed by 41-50 years occupying 31.8% .Mean age is 39.94 ± 8.01 years in moderate cases and 44.42 ± 10.36 years in severe cases . In non severe cases 64% showed Lymphopenia and 3.6% showed Normal lymphocyte percentage and in severe cases 32.2 % showed Lymphopenia. Conclusion : COVID-19 patients on admission showed marked lymphopenia. Careful evaluation of laboratory indices at admission can be helpful to clinicians in formulating a treatment approach and promptly provide intensive care to those who are in greater need.

***Keywords*---**COVID infection, lymphopenia, hematological parameters.

Introduction

Coronavirus disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a positive-strand RNA virus belonging to the family Coronaviridae with about 80% genomic similarities with SARS-CoV [1–3]. The incubation period of up to 14 days from the time of exposure, with a median incubation period of 4 to 5 days [4] .The most common clinical manifestations of COVID-19 include dry cough, fever, dyspnea, myalgia, fatigue, and lymphopenia COVID-19 is the constellation of clinical symptoms caused by the SARS-CoV-2

virus which range from mild respiratory symptoms to a severe and life-threatening form of pneumonia [5].In severe cases, the disease may cause acute respiratory distress syndrome (ARDS), arrhythmia, shock, secondary infections, acute heart damage, kidney failure, and even death [6,7].

Anemia is an independent risk factor for COVID-19-related severe illness, and healthcare providers should pay more attention to the hemoglobin levels of COVID-19 patients on admission. It was critical to be aware of anemia as a risk factor for COVID-19[8] .Two possible pathophysiological processes about the cause of anemia during COVID-19 infection have been identified in the scientific literature: first, SARS-CoV-2 can first bind with hemoglobin molecules on erythrocytes via the ACE2, CD147, and CD26 receptors, this viral-hemoglobin interaction causes the virus to target the heme on hemoglobin's 1-beta chain, resulting in hemolysis. Second, SARS-CoV-2 may imitate the effect of hepcidin, which raises circulating and tissue ferritin while causing serum iron shortage and hemoglobin insufficiency as a result. The resultant hyperferritinemia will cause ferroptosis, with significant oxidative stress and lipoperoxidation, which might trigger an inflammatory immune over-response (cytokine storm) and result in a catastrophic outcome [9]

Viral infection is well known to be associated with abnormal haematological parameters. Autopsy of patients who died of COVID-19 showed markedly shrunken spleen with reduced lymphocyte, macrophage proliferation, and phagocytosis [10]. In the Chinese population, studies have reported the presence of leukopenia on hospital admission, basically at the expense of moderate to severe lymphopenia and mild thrombocytopenia [11] . The review of studies that contained analyses of peripheral blood samples showed that a greater number of lymphopenic patients had the presence of reactive lymphocytes, of which a subset appeared to be lymphoplasmacytoid [11] .

Thus, the monitoring of these hematological parameters is essential and can assist in the identification of patients who will need care in the Intensive care unit, as they presented a deeper lymphopenia, as well as a decrease in hemoglobin, absolute monocyte count and even tend to develop neutrophilia during hospitalization, with a peak in this period of ICU stay [12]. Cytokine storm with elevation of interleukin (IL)-2R, IL-6, IL-1β, IL-8, IL-17, granulocyte colony-stimulating factor (G-CSF), tumour necrosis factor-α (TNF-α), IP10, MCP1, and MIP1α was seen in COVID-19 patients and may also lead to lymphopenia [13]. Lymphopenia is a common finding in viral infection. In a multicentre study including 1,099 patients from 552 sites in China, lymphopenia was present in 83.2% of patients on admission [14]. SARS-CoV-2 could trigger necrosis or apoptosis of lymphocytes resulting in lymphopenia.

Three possible mechanisms of thrombocytopenia in COVID-19 have been proposed [15]. First,SARS-CoV-2 may suppress thrombopoiesis. Coronaviruses can infect hematopoietic cells in the bone marrow, resulting in decreased hematopoietic potential. Human coronavirus(serogroup 229E) enters hematopoietic cells and platelets through aminopeptidase N (CD13) receptors and induces growth inhibition and apoptosis of hematopoietic cells, resulting in abnormal hematopoiesis and thrombocytopenia. Second, SARS-CoV-2 infection

may destroy platelets.COVID-19 may result in elevated levels of autoantibodies and immune complexes, leading to the specific destruction of platelets. Third, SARS-CoV-2 infection may trigger increased consumption of platelet. COVID-19 and inflammation resultin lung damage. Damaged pulmonary tissues and endothelial cells may activate platelets, resulting in platelet aggregation and microthrombi formation, increasing the consumption of platelets. Blood cell interactions are essential in the pathophysiology of inflammation, immune responses, hemostasis, and oncogenesis. Numerous observational studies have suggested that the neutrophil-to-lymphocyte ratio (NLR), lymphocyte proportion, and the platelet-to-lymphocyte ratio (PLR) are inflammatory markers of immune-mediated, metabolic, prothrombotic, neoplastic diseases, and are widely investigated as useful predictors for prognosis in many diseases.[16,17]

Aim of the study

To study haematological parameters in covid 19 patients in a teaching hospital, Telangana.

Materials & Methods

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from the all the cases included in the study.
Study design: Prospective and retrospective observational study.
Study period: Duration of 6 months ie, from November 2020 to April 2021.
Place of study : Prathima institute of medical sciences ,Karimnagar , Telangana.
Sample size: 220 patients

Inclusion criteria

- Age group range from 20 years to 70 years with covid 19 infection
- with a confirmed PCR diagnosis.
- The severity of COVID-19 patients was assessedby: patients admitted in hospital with confirmed pneumonia by lung CT, patients with respiratory distress (rate > 30 breaths/min) and oxygen capacity level < 93%, and patientsrequired intensive care unit (ICU) support or mechanical ventilation [23, 24].

Exclusion criteria

- Age less than 20 years old,
- pregnant women,
- patients taking medicine for reducing lymphocyte, leukocytes, or white blood cells count,
- patients previously diagnosed with any hematological disorders.

Methodology

220 patients with confirmed COVID-19 infection admitted to Prathima institute of medical sciences ,Karimnagar , Telangana were enrolled in this study. A confirmed case of Covid-19 was defined by a positive result on a reverse-

transcriptase– polymerase-chain-reaction (RT-PCR) assay of a specimen collected on a nasopharyngeal swab. Demographic characteristics including age ,gender ,past history ,present history and any drug history were noted . Thorough clinical history and clinical findings were noted.The pateints were categorised into moderate and severe cases based on history and HRCT findings . According to WHO clinical management of COVID-19 interim guidance of May 27, 2020, patients were categorized into three groups to assess disease severity.(18) Asymptomatic- SARS-CoV-2 nucleic acid test shows positive.Patients have no clinical symptoms or signs and the chest imaging is normal. Mild -Symptoms of acute upper respiratory tract infection (fever, fatigue, myalgia, cough, sore throat, runny nose, sneezing) or digestive symptoms (nausea, vomiting, abdominal pain, diarrhea)

Moderate Pneumonia- (frequent fever, cough) with no obvious hypoxemia, and chest imaging shows lesions. Severe -Pneumonia with hypoxemia (oxygen saturation < 92%) Critical- Acute respiratory distress syndrome (ARDS).Patients may have shock, encephalopathy,myocardial injury, heart failure, coagulation dysfunction, and acute kidney injury The blood samples were collected at the time of admission, in the EDTA anticoagulant vacutainer under all aseptic conditions . The samples were processed in Sysmex XN-1000 seven-part hematology analyzer. Hemoglobin (HB), Hematocrit (HCT), Red blood cell count (RBC), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), Red cell distribution width (RDW), WBC, Neutrophils (absolutecount), Lymphocytes (absolute count), Platelet count and MPV were noted .

Accordingly, anaemia was defined as hemoglobin (Hgb) value <13g/dl for males aged >15gm.dl (19) Diagnostic criteria for leukopenia: WBC < 4×10^9/L, for lymphopenia; moderate lymphopenia (absolute lymphocyte count [ALC] 0.5-1 × 10^9/L), and severe lymphopenia (ALC < 0.5×10^9/L). (20) Diagnostic criteria for thrombocytopenia: Mild thrombocytopenia (platelet count 100-150 × 10^9/L) and moderate thrombocytopenia (platelet count 50-100 × 109/L). (20) Cytopenia was defined as the presence of either anemia or leukopenia or thrombocytopenia, whereas bi-cytopenia was characterized as the presence of two forms of cytopenia. On the other hand, pancytopenia was defined as the presence of anemia, thrombocytopenia, and leukopenia in combination.(21)

Statistical analysis

We presented the haematological parameters as the mean ± standard deviation (mean ± SD). Here we compared the changes of parameters between severe COVID-19 patients (SCP) and non-severe COVID-19 patients (NSCP) using independent unpaired sample t-tests (Mann-whitney test for non-parametric data). We assessed the significance among different categorical variables using chi-square test (fischer's exact test). We performed data editing, sorting, coding, classification, and tabulation using Microsoft Excel. also, we applied IBM SPSS software (version 25.0) for all statistical analyses. We considered significant statistical variations or associations at a p-value less than 0.05.

Results & Observations

In our study 67.7% (149/220) cases showed moderate HRCT severity scores and 32.2 % (71/220) cases showed HRCT severity scores > 12 .

Table 1:Age and Gender distribution

Age (years)	Non severe cases (149)		Severe cases (71)		Total	P value
	Male	Female	Male	Female		
20-30 years	21 (9.5 %)	4(1.8 %)	4(1.8 %)	06(2.7%)	35(15.9 %)	<0.0001****
31-40 years	56(25.4 %)	16(7.2%)	13(%)	04(1.8 %)	89(40.4 %)	
41-50 years	26(11.8%)	18(8.1 %)	23(%)	03(1.3%)	70(31.8 %)	
51-60 years	05(2.2 %)	02(0.9 %)	08(%)	06(2.7 %)	21(9.5 %)	
61-70 years	02(0.9 %)	-	02(0.9 %)	01(0.4 %)	5(2.2 %)	
Mean age	39.94 ± 8.01		44.42 ± 10.36			
Total	110(%)	39(%)	50(%)	21(%)	220(99.9 %)	

*chi square test (fisher's exact test), ****= significant, p =< 0.05 significant

In our study majority were noted among 31-40 years constituting 40.4% (89/220) and followed by 41-50 years occupying 31.8% (70/220)

Mean age is 39.94 ± 8.01 in moderate cases and 44.42 ± 10.36 in severe cases .

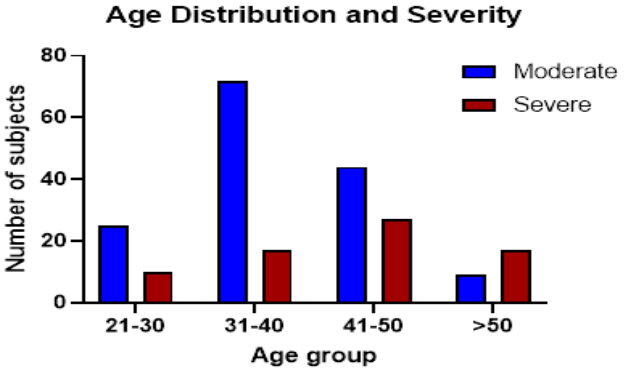
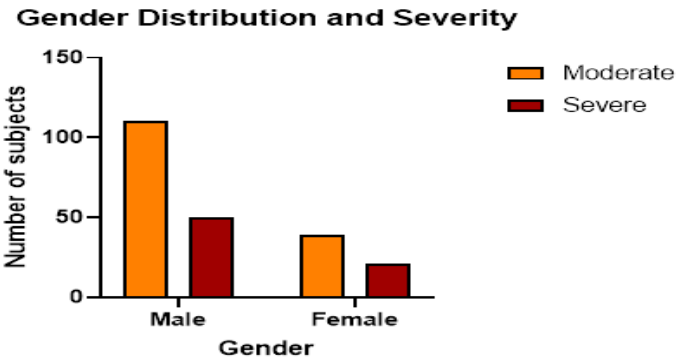


Table 2 : Gender and severity

Parameter	Non severe cases		Severe cases		Total	P value
	n	%	n	%		
Male	110	50	50	22.7	160	0.6289 ns
Female	39	17.7	21	9.54	60	

*Chi square test (fisher's exact test), ns= not significant



In non severe cases Cough + sore throat occupying 2.2 % (05/220) ,Fever +Cough + sore throat+ dyspnoea 46.3% (102/220) ,only Dyspnoea 0.9% (2/220) ,Fever +Cough + sore throat+ dyspnoea +Chest pain and Fever +Cough + sore throat+ dyspnoea +Petechiae constituting 5.9% (13/220),Both Fever +Cough + sore throat+ dyspnoea Associated with Abdominal Pain+ diarrhoea and ,Fever +Cough + sore throat+ dyspnoea Associated with Vomiting's occupying 3.1 % (07/220)

In severe cases Cough + sore throat occupying 1.3 % (03/220) ,Fever +Cough + sore throat+ dyspnoea 14.5% (32/220) ,only Dyspnoea 1.9% (04/220) ,Fever +Cough + sore throat+ dyspnoea +Chest pain 0.4%(1/220) and Fever +Cough + sore throat+ dyspnoea +Petechiae constituting 10.4% (23/220),Both Fever +Cough + sore throat+ dyspnoea Associated with Abdominal Pain+ diarrhoea 2.7%(06/220) and ,Fever +Cough + sore throat+ dyspnoea Associated with Vomiting's occupying 0.9 % (02/220)

Table 3: Co morbidities and severity

Parameter	Non severe cases		Severe cases		Total	
Hypertension alone	n	%	n	%		P value
Yes	23	15.44	16	22.54	39(17.7%)	0.6706 ns
No	126	84.56	55	77.46	181(82.3%)	
Diabetes alone						
Yes	47	31.54	20	28.17	67(30.45%)	0.6339 ns
No	142	68.46	51	71.3	193(69.54%)	
Diabetes & Hypertension						
Yes	12	8.1	12	16.9	24(10.9%)	0.0637 ns
No	137	91.9	59	83.1	196(89.1%)	
COPD						
Yes	11	7.38	5	7.04	16(7.27%)	>0.999 ns
No	138	92.62	66	92.96	204(92.73%)	
Comorbidities						
Yes	93	62.42	55	77.46	148(67.27%)	0.0313*
No	56	37.58	16	22.54	72(32.72%)	

*Chi square test (fisher's exact test), ****= significant, p =< 0.05 significant

Among the COVID-19 patients 32.72% did not have any comorbidity 67.27% had comorbidities among which Common were diabetes alone (67%), hypertension alone (17.7%), both diabetes and hypertension (10.9%) and COPD (7.27%). Overall, we observed that out of 220 67.27% had a history of comorbid diseases which was statistically significant for severity of disease on comparing non severe cases and severe cases .

Hematological findings

In our study in 18.1% (40/220) non severe cases showed hb < 7.0 g/dl (Severe anemia) 35.4% (78/220) 7.1-9.9 g/dl (moderate anemia) and 24.1% (31/220) showed 10.0 to 10.9 g/dl (mild anemia). 15.9% (35/220) severe cases showed hb < 7.0 g/dl (Severe anemia),13.1% (29/220) 7.1-9.9 g/dl (moderate anemia) and 3.1% (7/220) showed 10.0 to 10.9 g/dl (mild anemia) In non severe cases 67.2%(148/220) showed RBC count between 4.1 – 5.3 millions /cumm and 0.4% (01/220) had below 4.1 millions /cumm. In severe cases 32.2%(71/220) showed RBC count below 4.1 millions /cumm

In non severe 61.3%(135/220) showed WBC count < 4000/cumm and 6.3% (14/220) showed wbc count between 4000-11000/cumm.In severe cases 30.3%(67/220) showed WBC count < 4000/cumm and 1.8% (4/220) showed wbc count between 4000-11000/cumm. In non severe cases 64%(141/220) showed Lymphopenia and 3.6% (08/220) showed Normal lymphocyte percentage and in severe cases 32.2 % (71/220) showed Lymphopenia. In non severe cases 64%(141/220) showed thrombocytopenia and 3.6% (08/220) showed Normal platelet count and in severe cases 32.2 % (71/220) showed thrombocytopenia

In non severe cases on peripheral smear examination as Normochromic anemia in 20.9% (46/220) cases Microcytic Hypochromic anaemia observed in 18.6% (41/220) cases and 9% (20/220) as Macrocytic Normochromic anaemia . In severe cases on peripheral smear examination as Normochromic anaemia in 9% (20/220) cases. Microcytic Hypochromic anaemia observed in 31.8% (70/220) cases and 9.5% (21/220) as Macrocytic Normochromic anaemia .0.9%(02/220) .

In non severe cases PCV was decreased and ,MCV,MCH ,MCHC were normal in all Normochromic anemia 20.9% Decreased PCV ,MCV,MCH ,MCHC was observed in all Microcytic Hypochromic anaemia 18.6% cases and raised ,MCV,MCH and normal MCHC was noted in 9% of as Macrocytic anaemia . In severe cases PCV was decreased and ,MCV,MCH ,MCHC were normal in all Normochromic anemia (9%) Decreased PCV ,MCV,MCH ,MCHC was observed in all Microcytic Hypochromic anaemia 31.8% cases and raised ,MCV,MCH and normal MCHC was noted in 9.5 % of as Macrocytic Normochromic anaemia

Table 4: Hematological parameters of the study cohort at different severity levels of COVID-19

Parameter	non severe (Mean ± SD)	Severe (Mean ± SD)	P value
Hemoglobin	8.422 ± 1.872	7.463 ± 1.929	0.0006***
RBC	3.376 ± 0.3281	3.348 ± 0.3850	0.9026 ns

WBC	2330 ± 1005	2144 ± 990.4	0.1997 ns
DC-lymphocytes%	17.34 ± 4.849	15.77 ± 4.096	0.0340 *
neutrophils	76.73 ± 5.773	77.27 ± 5.345	0.9600 ns
eosinophils	1.604 ± 1.058	1.887 ± 1.202	0.0350 *
monocytes	4.114 ± 2.762	4.394 ± 3.054	0.6523 ns
PLT	52577 ± 29877	40369 ± 31738	0.0004 ***
PCV	25.17 ± 5.586	22.39 ± 5.782	<0.0001 ****
MCV	82.07 ± 12.69	81.70 ± 14.42	0.4255 ns
MCH	26.77 ± 6.781	26.03 ± 7.087	0.2684 ns
MCHC	31.28 ± 2.641	30.80 ± 2.887	0.2808 ns

*unpaired t test (Mann Whitney test), ****= significant, p =< 0.05 significant

The haematological alterations of the cohort is presented in Table 4. First, we compared haematological variations between SCP and NSCP. The SCP had lower RBC and significantly lower Hb levels than NSCP. The SCP showed lower WBC, neutrophils and significantly lower DC%-Lymphocytes, Platelets than NSCP. monocytes were more in SCP than NSCP, eosinophils were significantly more in SCP than NSCP. CRP. MCV, MCH and MCHC were non significantly lower in SCP compared to NSCP.

Discussion

Comparative studies related to Age distribution

In the Present study The study population comprised of 220 patients, 40.4% of the cases were between 31-40 years followed by 31.8% among 41-50 years . Mean age is 39.94 ± 8.01 in moderate cases and 44.42 ± 10.36 in severe cases .In a study done by Keval Arvindbhai Patel et al [22] The study population comprised of 50 patients . twenty-five patients being above 50 years. Eleven cases were between 51-60 years and 10 cases between 61-70 years of age group and four cases above 71 years.In Md. Ashrafur Rahman et al [23]73.40% of patients were above 40-years of age, and 36.60% of patients were below 40 years of age. Most of the participants were between 21–60 years old.

Comparative studies related to Sex distribution

In our study 77.2% were males and 27.2 % were females .In Md. Ashrafur Rahman et al study [23] of the 306 participants, 187 (61.11%) were male,and 119 (38.89%) were females.In Keval Arvindbhai Pate [22] , the study population comprised of 50 patients which comprised of 35 males (70 %) and 15 females (30 %) .

Comparative studies related to clinical features

Present study Hypertension noted in `7.7% cases , Diabetes in 30.4% ,Both DM + HTN in 10.9% cases and COPD in 7.2% cases and no comorbidities in 32.7% cases . In Md. Ashrafur Rahman et al (23) the Common comorbidities were diabetes (54.58%), hypertension (53.27%), and bronchial asthma (22%).

Comparative studies related to Hemoglobin investigations

In our study in 18.1% non severe cases showed hb < 7.0 g/dl (Severe anemia) 35.4% 7.1-9.9 g/dl (moderate anemia) and 24.1% (31/220) showed 10.0 to 10.9 g/dl (mild anemia). And 15.9% severe cases showed hb < 7.0 g/dl (Severe anemia),13.1% 7.1-9.9 g/dl (moderate anemia) and 3.1% showed 10.0 to 10.9 g/dl (mild anemia).In non severe cases 67.2% showed RBC count between 4.1 – 5.3 millions /cumm and 0.4% had below 4.1 millions /cumm. In severe cases 32.2% showed RBC count below 4.1 millions /cumm. In Keval Arvindbhai Patel [22] HB ranged from 8.2-15.5 gm%, with a median of 11.85 gm% (Mean 11.60 gm%, S.D. 1.1 gm%). HB was decreased in 18 cases (36%) according to age and gender. In Shambel Araya et al [24] Regarding anemia severity 12.57% and 1.2% of patients had mild and severe anemia, respectively

Comparative studies related to RBC distribution

In non severe cases 67.2% showed RBC count between 4.1 – 5.3 millions /cumm and 0.4% had RBC count below 4.1 millions / cumm. And In severe cases 32.2% showed RBC count below 4.1 millions /cumm. In Keval Arvindbhai Patel et al study [22] RBC Count ranged from 2.5 to 6.87 million, with a median of 4.72 million (Mean 4.66 million, S.D. 0.78 million). 14 cases (28 %) had reduced RBC mass ranging from 2.5-4.18 million, 34 cases (68%) had normal RBC mass while 2 cases (4%) had increased RBC mass as 6.45 and 6.87 million.

Comparative studies related to RBC INDICES

In our study In non severe cases mean + SD HCT was 25.17 ± 5.586 in non severe cases and 22.39 ± 5.782 in severe cases . Mean +SD of MCV 82.07 ± 12.69 in non severe and 81.70 ± 14.42 in severe cases ,Mean +SD of MCH 26.77 ± 6.781in non severe and 26.03 ± 7.087in severe cases ,Mean +SD of MCHC 31.28 ± 2.641in non severe and 30.80 ± 2.887 in severe cases .In Keval Arvindbhai Patel et al study [22] HCT ranged from 24.8-52%, with median of 37.1% (Mean 36.81%, S.D. 6.97%). HCT was decreased in 23 cases (46%), values ranging from 10.4-35.8%. Two cases showed raised HCT of 50.4 and 52%. The rest of the cases had normal HCT ranging from 36.5-46.5%. MCV ranged from 54.7-110.8 fl, with a median of 80.75 fl (Mean 79.8%, S.D. 9.8%). In 7 cases (14%) MCV was decreased ranging from 54.7-74.2 fl while 3 cases (6%) had increased MCV ranging from 95.7-110.8 fl. The rest of the cases showed MCV within the normal range for the given age groups. MCH ranged from 16.9-38 pg (Mean 27.8%, S.D. 3.6%). In 16 case (32%) MCH was decreased ranging from 16.9-27.4 pg and 2 cases (4%) had increased MCH (33.5 & 38 pg).. MCHC (Mean 33.8%, S.D. 1.5%). In 15 cases (30%) MCHC was decreased ranging from 30.9-33.2 g/dl and 6 cases (12%) had increased MCHC value ranging from 35.8 to 37 g/dl.

Comparative studies related to WBC distribution

In our study non severe cases 64%showed Lymphopenia and in severe cases 32.2 % showed Lymphopenia. In non severe cases 64%showed Leukopenia and in severe cases 32.2 % showed Leukopenia. In non severe cases 64% showed thrombocytopenia and in severe cases 32.2 % showed thrombocytopenia. In Guan

et al [25] majority of patients presented with lymphocytopenia (83.2%), whereas 36.2% had thrombocytopenia, and 33.7% showed leukopenia. These haematological abnormalities were more prominent among severe versus non-severe cases (96.1% versus 80.4% for lymphocytopenia, 57.7% versus 31.6% for thrombocytopenia and 61.1% versus 28.1% for leukopenia). In Keval Arvindbhai Patel [22] leukopenia was noted with TLC of 3.4 & 3.6 x 10^9/L. Thirty-eight cases (76%) had normal leucocyte count ranging from 4.03-10.35 x 10^9/L including one infant with a TLC of 12.9 x 10^9/L. Ten cases (20%) had leucocytosis ranging from 12-23 x10^9/L /L. All these cases with high TLC showed neutrophilic predominance. The differential count in patients with leucopenia showed lymphocytic predominance in one case while neutrophilic predominance in the other case. The absolute neutrophil count ranged from 0.87-19.7 x10^9/L /L with median of 6.8 x109/L (Mean 5.4 x109/L, S.D. 4.3 x109/L). Only one case (2%) showed moderate neutropenia 0.87 x109/L. Absolute lymphocyte count ranged from 0.37-3.28 x10^9/L. The median of absolute lymphocyte count was 1.12 x109/L (Mean 1.2 x109/L, S.D. 1.21 x 10^9/L). Absolute lymphopenia featured in eighteen patients (36%) with fifteen patients (30%) having moderate lymphopenia (range: 0.52-0.96 x10^9/L /L) and three patients (6%) with severe lymphopenia (range: 0.37-0.49 x 10^9/L

Shambel Araya et al study [24] the most common hematological abnormality among COVID-19 patients was lymphopenia (72.2%). The study also showed that only 7.3% of moderate and 2.4% of critical patients had leukopenia, with no statistical association (P=0.39).In the binary logistic regression analysis of combined lymphopenia-neutrophilia with disease severity, COVID- 19 patients with severe and critical disease had 4.1- and 3.3-times increased odds of having combined lymphopenia-neutrophilia, respectively, than moderate patients with a significant association (P<0.005).The magnitude of lymphopenia was highest in the age group of ≥ 56 years (78.7%) with no statistical significance (P=0.25). The magnitude was also almost similar among critical (75.6%), severe (65.0%), and moderate (73.4%) COVID-19 patients with no significant association with disease severity .

Comparative studies related to Platelet count

In our study non severe cases 64%(141/220) showed thrombocytopenia and 3.6% (08/220) showed Normal platelet count and in severe cases 32.2 % (71/220) showed Thrombocytopenia. In Keval Arvind Bhai Patel et al study [22] 06 cases (12.0%) had mild thrombocytopenia and 2 patients (4%) had moderate thrombocytopenia in both cases.38 cases (76%) had normal platelet count . In Shambel Araya et al [24]The findings of this study showed that thrombocytopenia was more frequent among females (24.6%) (P=0.28) and younger (18–35years) (23.9%) COVID-19 patients. However, thrombocytopenia did not show a significant difference among gender and age groups (P>0.05).

Platelet count has been evaluated as a biomarker to predict the severity of COVID-19 in multiple studies, but the results were confounded by heterogeneity regarding definitions of thrombocytopenia and endpoints used. Two meta-analyses showed that a lower platelet count is associated with an increased risk of severe disease and mortality in patients with COVID-19 and may serve as a

marker for progression of illness [26]. In the multicentre study by Guan et al [25], thrombocytopenia (platelet count < 0.0001). Thrombocytopenia-associated bleeding is uncommon in COVID-19. Platelet transfusion is recommended in patients with active bleeding and a platelet count less than 50 × 10^9/L /L. For patients at high risk but without active bleeding, platelet transfusion may be considered if the platelet count is less than 20–25 × 10^9/L /L .

Conclusion

COVID-19 patients on admission showed marked lymphopenia, leukopenia, and thrombocytopenia. Other hematological parameters did not show any significant changes. Careful evaluation of laboratory indices at admission can be helpful to clinicians in formulating a treatment approach and promptly provide intensive care to those who are in greater need.

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