Hematological Characteristics and their Prognostic Evaluation in COVID-19 Cases

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Abstract: *Introduction: Corona virus has become a major threat to public health worldwide which causes fatal respiratory disease and long-term morbidity and mortality. Study of hematological parameters and their correlation with clinical profile, helps the clinician to assess severity and prognosis of patients with COVID-19. Early identification of potentially lethal complications including Disseminated Intravascular Coagulation with effective intervention can improve patient's outcome. [1] Aims and objectives: The study was done to observe hematological parameters in COVID-19 cases and to correlate them with clinical profile as well as other investigations. Material and Methods: The cross sectional and observational study of all the hematological parameters in 700 indoor patients, admitted with COVID-19 infection, in the Department of Pathology in a tertiary care centre from August 2020 to July 2022. Results: Out of 700 cases, 206 patients were more than 60 years of age and male preponderance was also noted. Most common symptom was fever. Severity of illness increased with increase in total leucocyte count, neutrophil count, erythrocyte sedimentation rate, D-Dimer levels and decrease in hemoglobin levels, lymphocyte count and platelet count. Most common cause of death was Acute Respiratory Distress Syndrome.*

Keywords: COVID-19 infection, hematological parameters, prognostic evaluation.

1. Introduction

In the last decades, Corona virus has become a major threat to public health worldwide which causes fatal respiratory disease and long-term morbidity and mortality.

Corona virus (COVs) are a large viruses group belonging to the Coronaviridae family [2, 3], presenting as a single-stranded RNA genome and appears like a crown. [4]

When infecting humans, Corona virus can cause disease of varying severity, from upper respiratory tract infections similar to common cold, to lower respiratory tract infections such as pneumonia, bronchitis and Severe Acute Respiratory Syndrome (SARS) as well as hepatic, enteric and neurological diseases. [2, 4, 5]

Currently there is no proved antiviral treatment for COVID-19 [6] and knowledge about SARS-CoV-2 is still scarce. Daily, reported cases and death number increase considerably in numerous regions of the planet. In this context, early diagnosis and infection prevention has become one of the priorities for the control of this Corona virus. [7]

Review on hematological changes in SARS-CoV-2 infection, whose knowledge by health professionals could be useful in the management of disease.

According to meta-analysis, leucocytosis, lymphopenia and thrombocytopenia are associated with greater severity and even fatality in COVID-19 cases. [8]

Along with these hematological changes other laboratory investigations which are useful to monitor disease outcome are D-Dimer levels, Liver function test, Serum creatinine levels, Serum Ferritin levels and High resolution computerised tomography. [9, 10, 11]

Hence, to study of hematological parameters and their correlation with clinical profile, helps the clinician to assess severity and prognosis of patients with COVID-19.

2. Materials and Methods

A two years, Cross sectional and observational study of 700 adult cases, admitted with COVID-19 infection in a tertiary care center from August 2020 to July 2022 was done.

The data of the patients including patient's age, sex, complaints, clinical presentation and laboratory investigations were recorded in all cases. According to Ministry of Health and Family Welfare, patients were divided into mild, moderate and severe group of illness. [12]

Routine hematological examinations viz. Hemoglobin levels, Total leukocyte counts, Differential leucocyte counts, Platelet counts and Erythrocyte sedimentation rate were performed in hematological laboratory. Hemoglobin levels, Total leukocyte counts, Differential leucocyte counts and Platelet counts were recorded on 5-part Automated Hematology analyser (Nihon Kohden MEK– 9100K). Peripheral blood smears were also made from venous blood collected in E. D. T. A. vacutainer. Smears were stained by Leishman stain and morphology of RBC, WBC and platelets were studied.

Other tests like Erythrocyte sedimentation rate and D-Dimer levels were performed. Stago STA Satellite Max fully automated machine was used for coagulation tests.

Other investigations were reviewed from patient's clinical record.

The data collected was statistically analysed by using SPSS software, to find out the correlation of hematological

parameters with clinical profile as well as other investigations like Liver function test, Serum creatinine, Serum Ferritin, D-Dimer and High resolution computerized tomography of clinically diagnosed cases of COVID-19 infection.

Inclusion criteria

All cases admitted with COVID-19 infection above 17 years of age.

The study was done after getting ethical clearance from Institutional ethics committee.

3. Observation and Results

Total 700 COVID-19 infection positive cases were obtained within a period of 2 years from July 2020 to August 2022, which was based on observational and cross-sectional study.

The age group ranged from 18 to 93 years with male preponderance (69.14%).

Most common clinical presentation was fever 573 (81.85%), followed by 472 (67.42%) dry cough, 402 (57.42%) generalized weakness, 302 (43.14%) breathlessness, 154 (22%) loss of taste and smell, 27 (3.8%) sore throat and 46 (6.57%) of patients were categorized as other symptoms. Other symptoms included patients with 15 (2.14%) cold, 14 (2%) nausea, 12 (1.71%) headache, 5 (0.71%) loss of appetite, 1 (0.14%) pain in abdomen.

These patients were divided into mild, moderate and severe group of illness. Maximum number of patients were seen in moderate group 533 (76.14%), followed by severe group 95 (13.57%) and minimum patients in mild group 72 (10.28%).

Co-morbidities like age > 60 years, diabetes mellitus, hypertension, kidney disease, respiratory disease, thyroid disease and liver disease were significantly associated with severity of illness. (Figure 1)
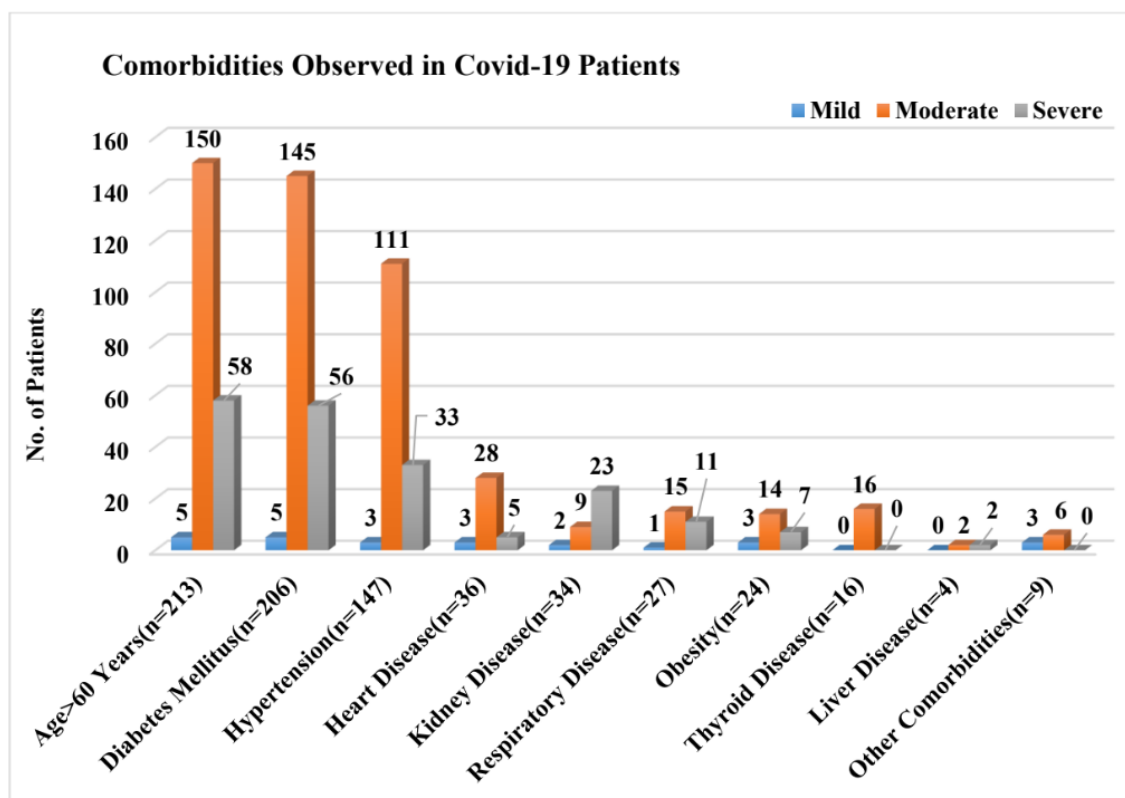

Figure 1: Comparison between severity of illness observed and Co-morbidities present among COVID-19 Cases

Complications like Disseminated Intravascular Coagulation (DIC) [100 (14.2%) of 700], Acute Respiratory Distress Syndrome (ARDS) [66 (9.4%) of 700] and Mucormycosis [16 (2.2%) of 700] were also noted in severely diseased COVID-19 infected patients. (Figure 2)
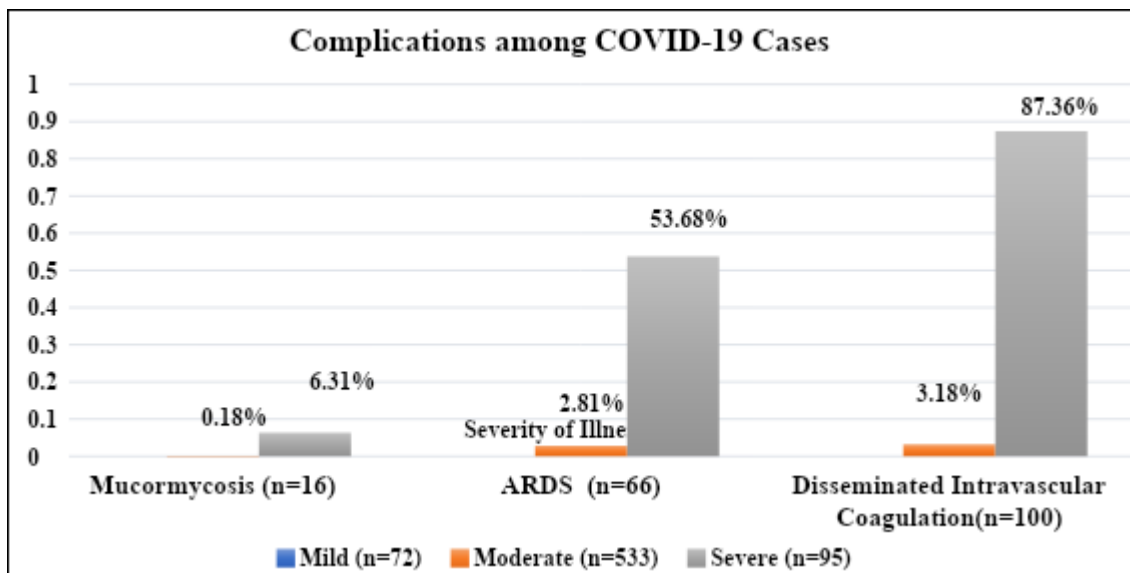
Figure 2: Comparison of Severity of illness and Complications among COVID-19 Cases

Analysis of hematogical profile showed low haemoglobin levels, leucocytosis, neutrophilia, lymphopenia, normal to reduced platelet count, increased absolute neutrophil count, decreased absolute lymphocyte count, high erythrocyte sedimentation rate, increased random blood sugar levels and high D-Dimer levels with increased severity of illness. Peripheral smear showed vacuolated neutrophils and atypical lymphocytes.

Biochemistry parameters like Serum ferritin levels, Lactate dehydrogenase levels, Procalcitonin levels, Liver enzymes (Aspartate transaminase, Alkaline phosphatase) levels (Table 1), Serum creatinine levels were found to be raised as the severity of illness increases. More positive cases with C-Reactive protein (Figure 3) were noted in severe group as compared to mild and moderate group of illness. (Table 2)

Table 1: Comparison between severity of illness and liver function tests among COVID-19 cases.

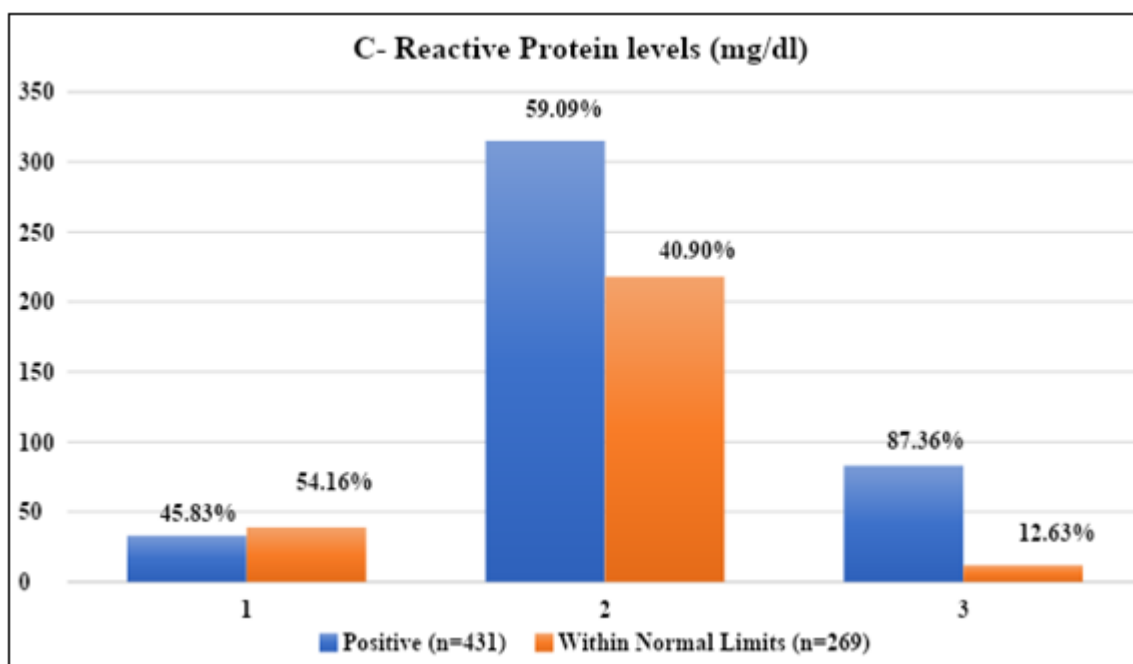| Liver Function Tests	Severity of illness		
	Mild (n=72)	Moderate (n=533)	Severe (n=95)
Raised Alkaline phosphatase (n=6)	1 (1.38%)	4 (0.75%)	2 (2.10%)
Raised Aspartate transaminase (n=145)	6 (8.33%)	80 (15%)	59 (62.10%)
Raised Alanine transaminase (n=16)	1 (1.38%)	11 (2.06%)	4 (4.21%)
Within normal limits (n=532)	64 (88.88%)	438 (82.17%)	30 (31.57%)
Total (n=700)	8 (11.11%)	95 (17.82%)	65 (68.42%)
Chi-square Value	124.70		
p-value	<0.0001*		

Figure 3: Comparison between severity of illness and C-Reactive protein among COVID-19 cases.

Table 2: Hematological and biochemical parameters in COVID-19 cases

S. No.	Parameters	Normal Range	Severity of illness		
			Mild	Moderate	Severe
1.	Mean Haemoglobin level	12-15 gm/dl	13.10 ± 1.89	11.89 ± 1.72	10.63 ± 2.16
2.	Mean Total Leucocyte Count	4000-11000/mm3	6323.88±1736.7	10672.36 ± 5270.5	11559.52 ± 6298.5
3.	Mean Neutrophil count	40-75%	64.84 ± 12.09	71.62 ± 11.56	85.43 ± 5.74
4.	Mean Lymphocyte Count	20-50%	32.25 ± 12.37	24.04 ± 10.43	12.98 ± 5.00
5.	Mean Platelet Count	1.5 – 4.5 Lakhs/mm3	2.51 ± 0.70	1.9 ± 0.76	1.64 ± 1.12
6.	Mean Absolute Neutrophil Count	2500 – 6000/ mm3	4127.34 ±1494.27	7616.61 ± 3966.26	10038 ± 5466.82
7.	Mean Absolute Lymphocyte Count	1000-3000/mm3	2586.77 ± 1882.8	2025.29 ± 934.29	1477.55 ± 856.1
8.	Erythrocyte Sedimentation Rate	Male: 0 – 15 mm/hour Female: 0 – 20 mm/hour	30.76 ± 19.72	47.93 ± 26.87	55.07 ± 28.49
9.	Mean D-Dimer level	0-0.5 mg/ L	1.19 ± 1.77	1.86 ± 1.74	2.75 ± 2.73
10.	Mean Serum Ferritin levels	Female: 4.6 – 204 ng/mL Male: 21.8 –274.6 ng/mL	200.46 ± 144.11	433.50 ± 294.80	541.01 ± 306.93
11.	Mean Lactate Dehydrogenase levels	200 – 400 IU/L	444.95 ±307.26	614.12 ± 253.58	782.04 ± 319.70
12.	Mean Procalcitonin levels	< 0.5 ng/mL	1.38 ± 1.37	3.13 ± 1.15	4.54 ± 1.88

Abnormal radiological changes in Chest X-ray and High resonance computed tomography were noted with severe disease. (Figure 4)

It is observed that more number of deaths noted in severe group followed by moderate and mild group of illness. Total 67 (9.5%) of 700 deaths occurred. Statistically deaths were noted more in patients with co-morbidities (85.07%).

Number of deaths was 52.63% in severe group, 3% in moderate group and 1.38% in mild group of illness.

Most common cause of death was found to be Acute Respiratory Distress Syndrome (ARDS) in 33 patients, followed by ARDS with septic shock and metabolic acidosis in 28 patients, Multiple Organ Dysfunction Syndrome (MODS) in 4 patients and Cardiogenic shock in 2 patients.
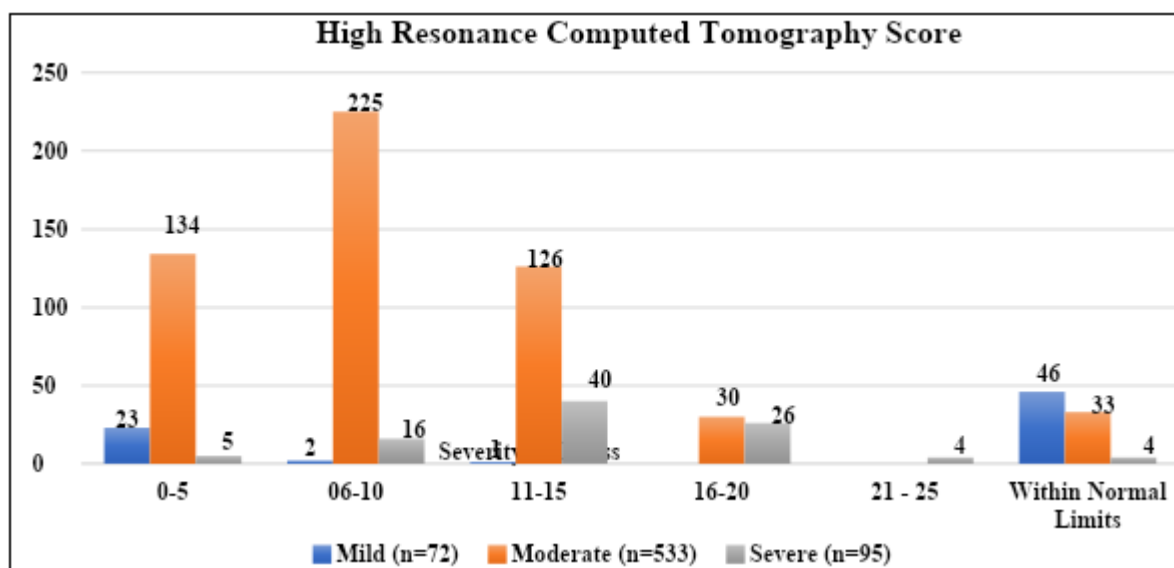

Figure 4: Column chart showing comparison of severity of illness and high resonance computed tomography among COVID-19 cases

4. Discussion

Maximum number of cases in our study of COVID-19 infection were more than 60 years of age with male preponderance. Similar findings were observed in studies conducted by Lokwani et al[13], Lingshuang Sheng et al[14] and Vineet banga et al[15]. Clinical presentation in COVID-19 infection was 573 cases of fever were found, followed by dry cough, generalized weakness, breathlessness, loss of taste and smell, sore throat and other clinical symptoms which includes cold, nausea, headache, loss of appetite and pain in abdomen in the present study. Similar findings were noted by Huang C et al[16], Chen et al[17], Chowdhury, Oommen et al[18] and Adekunle Sanyaolu et al[19].

Patients with co-morbidities had severe disease progression which was statistically significant. Complications of disease were Disseminated Intravascular Coagulation (DIC), Acute Respiratory Distress Syndrome (ARDS) and Mucormycosis. Similar study was done by Lingshuang Sheng et al[13], Chen X et al[20], Wu C et al[21], Liao D et al[22] and Farghly Youssif S et al[23].

Hematological parameters were deranged with the increased severity of illness low hemoglobin levels, leucocytosis, neutrophilia, lymphopenia, normal to reduced platelet count,

increased absolute neutrophil count, decreased absolute lymphocyte count, high erythrocyte sedimentation rate and high D-Dimer levels. Similar findings were analysed by Lokwani et al[12], Sana and Avneesh et al[24], Zhang et al[25], Gong et al[26], Mousavi-Nasab SD. et al[27], G.-Q. Qian[28], Guang Chen et al[29], H. Li, X. Xiang[30], Mengyao Ji et al[31] and Lingshuang Sheng et al[13].

In the study, 48.57% cases revealed increased blood sugar levels. Increased blood sugar levels causes poor prognosis of COVID-19 infected patients. Similar study was conducted by G. P. Fadini et al[32] and Zhu B et al[33].

Biochemistry parameters like Serum ferritin levels, Lactate dehydrogenase levels, Procalcitonin levels, Liver enzymes (Aspartate transaminase, Alkaline phosphatase) levels, Serum creatinine levels were found to be raised as the severity of illness increases. More positive cases with C-Reactive protein were noted in severe group as compared to mild and moderate group of illness. Similar studies were conducted by Lokwani, et al[12], Guang Chen et al[28], Sana and Avneesh et al[23], ZHANG et al[24], Mengyao Ji et al[30], C. Fernández Carrillo et al[34], Vineet banga et al[14] and G.-Q. Qian et al[27].

In present study, as the severity of illness increase, chest HRCT score also increased. Out of 700 patients, 617 (88.14%) patients had positive chest HRCT findings. 620 (88.57%) abnormal Chest X-Ray findings were also noted. Paul D et al[35], Sharifpour et al[36], Yasin R et al[37] and Sathi S et al[38] observed same results.

More number of deaths noted in severe group followed by moderate and mild group of illness and the most common cause of death was Acute Respiratory Distress Syndrome (ARDS) in the present study. Similar findings were noted by Saeed GA et al[39] and S. F. Koya et al[40].

5. Conclusion

Study of hematological parameters and their correlation with clinical profile, helps the clinician to assess course, outcome and severity of patients with COVID-19 illness and can plan treatment at an early stage.

Consent
As per international standard or university standard, patient's written consent has been collected and preserved by the author (s).

Ethical approval
As per international standard or university standard, patients written approval has been collected and preserved by the author (s).

Completing interests
Authors have declared that no competing interests exist.

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