ORIGINAL ARTICLE

Clinical and laboratory characteristics of COVID-19 infection in patients presenting to a tertiary care hospital

Huma Batool[1]*, Asifa Karamat[2], Khalid Waheed[3], Sohail Anwar[4], Syed Arslan Haider[5], Syed Mazhar Ali Naqvi[6], Munaza Javed[7]

Biomedica - Official Journal of University of Health Sciences, Lahore, Pakistan
Volume 37(3):179-184
https://doi.org/10.51441/BioMedica/5-497

ABSTRACT

Background and Objective: COVID-19 disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) having a wide variety of clinical features ranging from asymptomatic carriers to respiratory failure requiring mechanical ventilation. The objective of the study was to analyze the spectrum of different symptoms, laboratory findings, and complications in patients who were admitted in either COVID ward or intensive care unit (ICU) of a local hospital.

Methods: A retrospective cohort study of the medical records of 100 COVID-19 disease patients with polymerase chain reaction (PCR) detected SARS-CoV-2 infection were collected. Participant information was retrospectively obtained from the hospital medical records which included clinical records and laboratory findings. All statistical analyses were done using Statistical Package for the Social Sciences version 21.

Results: The mean age of the patients was 50.8 ± 5.86 with male predominance (79%). Most frequent co-morbidities were diabetes mellitus (42%) and hypertension (36%). Most frequent symptoms were fever (95.9%) and fatigue (95.9%) followed by dry cough (86.5%), myalgia (85.1), and shortness of breath (70%). Amongst the patients admitted, leukocyte count was 10.95 × 10^3, C-reactive protein was 12.8 mg/dl, ferritin was 730.8 ng/ml, and lactate dehydrogenase was found to be 1,254.7 U/l. Hepatic and renal functions were borderline deranged.

Conclusion: COVID-19 disease has a wide spectrum of clinical symptoms. Patients with raised inflammatory markers have severe disease and are more likely in need of an ICU care. By carefully observing these markers may help in better management of COVID-19 disease.

Keywords: Coronavirus, intensive care unit, COVID-19, complications, laboratory markers.

Received: 11 August 2021 **Revised date:** 03 September 2021 **Accepted:** 11 September 2021

Correspondence to: Huma Batool
*Assistant Professor of Pulmonology, Lahore General Hospital, Lahore, Pakistan.
Email: humabatool3@gmail.com
Full list of author information is available at the end of the article.

Introduction

COVID-19 disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It is highly communicable virus. The first case was reported in China by the end of December 2019 and till July 2020 more than ten million cases were reported worldwide.[1] A rapid surge in cases has led to the collapse of health-care systems in several countries. There is day-by-day increase in cases in Pakistan also. Therefore, the understanding of the clinical spectrum of the disease, laboratory findings and their association with disease severity is very crucial in triage and efficient management of the patients.

Novel coronavirus disease (COVID-19) has a variety of clinical features ranging from asymptomatic carriers of the disease to respiratory failure requiring mechanical ventilation.[2] According to the literature available, number of patients who need intensive care unit (ICU) care cannot be certain but 6.1% are classified as critical (multi-organ failure, needing mechanical ventilation), while 13.8% as severe (oxygen saturation less than 90% on room air requiring oxygen). Worldwide data shows that mostly affected individuals belong to old age ranging from 65-85 years.[3] China, the first hit country by novel coronavirus, reports age range from 10 to 80 years.[4] Clinically, novel coronavirus disease has a wide range of clinical and laboratory parameters. The most common feature is fever (98.6%) followed by fatigue, cough, muscular pain, dyspnea, and less frequently headache,

dizziness, abdominal pain, diarrhea, nausea, and vomiting.[1,5] Coronavirus more commonly infects people with different comorbidities including hypertension (HTN), diabetes, cardiovascular and cerebrovascular disorders.[6-9]

As currently there is no definitive treatment available for novel coronavirus disease, association of laboratory parameters with severity and potential need of intensive care is quite important. Fan et al.[10] analyzed that hematological index relates to severity of disease in COVID-19-infected patients. Common hematological abnormalities are lymphocytopenia, thrombocytopenia, leukopenia, and high C-reactive protein (CRP) levels.[2,11] Liver enzyme derangement is also expected, though data is limited, as was seen in SARS and middle east respiratory syndrome.[12,13]

The authors studied the clinical as well as laboratory parameters of SARS-CoV-2 which helps in understanding the characteristics of this emerging disease. Moreover, with careful observation of clinical and laboratory parameters, the future requirement of ICU admission in these patients can be ascertained.

Methods

It was a retrospective study of the medical records of 100 COVID-19 disease patients with PCR proven SARS-CoV-2 infections who were admitted in isolation wards and ICU of Lahore General Hospital, Lahore, Pakistan. Diagnosis was made through RT-PCR of the nasal swabs of all patients. The study was approved by Ethical Review Committee of Post Graduate Medical Institute/ Ameer-ud-Din Medical College Lahore General Hospital Lahore (Reference No. 00-125-20, Dated: 20-07-2020). The duration of this study was 3 months from August 2020 to September 2020. Patients who were ≥18 years with RT-PCR positive for SARS-CoV-2 were included in this study, whereas patients with missing data and having negative real time polymerase chain reaction (RT-PCR) were excluded.

Patient information was retrospectively obtained from the hospital medical records. Detailed clinical history and physical examination were done on the day of admission, and complete blood counts, liver function tests, renal function tests, CRP, lactate dehydrogenase (LDH), serum ferritin, and serum electrolytes were performed within the 48 hours following admission.

Statistical analysis

Statistical Package for Social Sciences version 21 was used in this study. Descriptive statistics like mean, standard deviation, frequency, and percentages were collected for demographics and clinical characteristics. Independent *t*-test was used to find out the differences between patients in ward and ICU with different laboratory test reports.

Results

The mean age of the patients enrolled was 50.8 ± 5.86 SD with 79% male and 21% female. Eighty-eight percent of the population belonged to urban area, while the rest (12%) were from rural areas. Majority (65%) were nonsmokers. Most frequent comorbidities were diabetes mellitus (42%) and HTN (36%). Most frequent symptom was fever (95.9%) and fatigue (95.9%) followed by dry cough (86.5%), myalgia (85.1%), and shortness of breath (70%).

Mean saturation of the patients on presentation was 89.7 ± 5.59. Mean leucocyte count was 10.95 ± 5.10, predominantly including neutrophils (67.8%) followed by lymphocyte (14.4%). Among inflammatory markers, mean CRP was 12.8 ± 5.70, serum ferritin 730.8 ± 3.27, and LDH 1,254.7 ± 3.47. D-Dimers were markedly raised (13.8 mg/l). Bilirubin levels were 0.98 mg/dl while liver enzymes were slightly raised [alanine aminotransferase (ALT) = 71.8 U/l, aspartate aminotransferase (AST) = 76.8 U/l]. Initial serum creatinine and urea was nearly normal in the study population although quite a few (*n* = 23) developed renal involvement later on during the disease course (Table 1).

More than half (68%) of patients recovered, while 12% patients expired; however the rest of 20% were hospitalized at the time of data collection.

Independent *t*-test was used to find out the differences of COVID-19 patients who were admitted in ward and ICU with different laboratory tests findings. According to the findings, significant differences were observed in SPO_2, WBCs, Hb, lymphocytes, platelets, CRP, ferritin, and D-dimers between patients in ward and ICU. It was seen that patients who were admitted in ICU showed higher levels of WBCs, CRP, ferritin, and D-dimer levels as compared to patients in the wards. It was also noted that patients admitted in the ward had more SPO_2, Hb, lymphocytes, and platelets as compared to ICU patients. Moreover, no significant differences were found between the patients admitted in wards and ICU with reference to creatinine, bilirubin, urea, AST, ALT, sodium, potassium, LDH, and neutrophil counts (Table 2).

Discussion

Male gender, old age, and comorbidities including active cancer, coronary artery disease, liver and kidney dysfunctions, chronic obstructive pulmonary disease, diabetes, and hypercholesterolemia are the factors associated with mortality among patients with COVID-19 who were admitted to ICU.[14,15] The knowledge of common clinical features and laboratory characteristics can help in accurately predicting the presence of infection and severity of disease in patients with COVID-19 infection. In the previous viral epidemics, old age was a prime predictor of mortality.[16,17] The mean age reported in the present study coincides with most of the other

Table 1. *Demographic, clinical characteristics, and complications during course of disease of studied sample (N = 100).*

Variables	Frequency (*n*)	Percentage
Demographic characteristics		
Age (mean)	50.8 ± 5.86 S.D.	
Gender (%) Male Female	 79 21	 79 21
Area Urban Rural	 88 12	 88 12
Smoking status Non smoker Smoker	65 35	 65 35
Comorbidities Diabetes mellitus HTN Ischemic heart disease (IHD) Malignancy Stroke Asthma Active tuberculosis Hypothyroidism	 42 36 7 1 1 1 1 1	 42 36 7 1 1 1 1 1
Complications		
Pneumonia Respiratory failure Acute respiratory distress syndrome (ARDS) Septic shock Acute kidney injury (AKI) Disseminated intravascular coagulation	76 68 30 9 23 11	76 68 30 9 23 11
Laboratory characteristics		
	Mean (*M*)	**Standard deviation (SD)**
Oxygen saturation (SpO2) White blood cell count (WBC) $\times 10^3$(µ/l) Hemoglobin (Hb) (g/dl) Neutrophils Lymphocytes Platelets (µ/l) LDH (U/l) CRP (mg/dl) Ferritin (ng/ml) Bilirubun (mg/dl) AST (U/l) Alanine amino transferase (U/l) Urea (mg/dl) Creatinine (mg/dl) D-Dimers (mg/l) Sodium (mEq/l) Potassium (mEq/l)	89.76 10.95 12.43 67.79 14.35 267,287.67 1,254.71 12.83 730.83 0.98 76.81 71.86 55.88 1.19 13.8 137.58 4.12	±5.59 ±5.10 ±1.67 ±4.77 ±3.27 ±5.43 ±3.47 ±5.70 ±3.27 ±0.72 ±6.10 ±2.20 ±4.27 ±0.44 ±1.25 ±3.88 ±0.48

studies.[5,6,8] The current study showed male predominance which is also observed in different studies.[5,18,19] Diabetes, HTN, and IHD were the most frequent comorbidities reported in this study which are similar to the results of different studies.[14,16,20] High prevalence of diabetes mellitus exists worldwide which leads to an immunosuppressed state which results in catching different infections.[16] Majority of our patients were nonsmokers (65%); however, a study by Zhang et al.[21] found more prevalence of COVID-19 in the smokers.

Most frequent clinical manifestations of patients in the current study were fever, dry cough, and dyspnea; however; sore throat, fatigue, diarrhea, muscle and joint pains, nasal

Table 2. *Comparison of patients in ward and ICU during COVID 19 (N = 100).*

Variables	In ward (*n* = 35)	In ICU (*n* = 65)	*p*	*t*	Confidence interval	
	M (SD)	*M* (SD)			Lower	Upper
SPO2	91.87 (5.76)	89.17 (5.51)	0.003	-3.02	-7.21	-1.80
WBCs	8.51 (4.09)	12.25 (5.14)	0.002	-3.14	-6.11	-1.36
Hb	12.97 (1.09)	12.17 (1.86)	0.005	3.19	0.12	1.59
Neutrophil	67.12 (3.99)	69.12(6.02)	0.81	-0.24	-19.21	15.21
Lymphocytes	23.36 (2.29)	9.14 (1.65)	0.000	4.83	8.30	20.15
Platelets	315,730.76 (4.53)	240,489.36 (3.76)	0.02	2.36	11,529.51	13,895.31
LDH	762.93 (5.78)	1,426.25 (4.56)	0.09	-1.69	-1,445.51	118.86
CRP	10.59 (5.48)	17.76 (3.64)	0.04	-2.12	-12.19	-5.13
Ferritin	678.83 (3.95)	753.66 (4.33)	0.03	-2.27	-309.20	-240.53
Bilirubin	0.90 (.25)	1.02 (.48)	0.51	-0.66	-0.47	0.23
AST	62.92 (1.79)	84.19 (7.04)	0.23	-1.22	-56.18	13.64
ALT	71.64 (3.73)	71.97 (5.83)	0.98	-0.02	-36.25	35.57
Creatinine	1.09 (0.37)	1.25 (0.47)	0.15	-1.46	-0.37	0.06
Urea	46.07 (4.57)	61.19 (3.69)	0.07	-1.84	-31.48	1.26
D-Dimers	40.46 (0.29)	92.97 (0.41)	0.04	-2.11	-375.13	-190.12
Sodium	136.88 (3.93)	137.96 (3.85)	0.26	-1.14	-2.95	0.81
Potassium	3.99 (0.37)	4.19 (0.51)	0.08	-1.75	-0.43	0.02

M = mean, *n* = total number, SD = standard deviation, SPO2 = pulse oximetry, WBC = white blood cells, Hb = hemoglobin, LDH = lactate dehydrogenase, CRP = C- reactive protein, AST = aspartate aminotransferase, ALT = alanine aminotransferase.

congestion/rhinorrhea, and headache were also encountered but less frequently. These findings are in accordance with other studies.[8,11]

We observed a higher mean leukocyte count as compared to other studies probably because many of our patients had critical illness and admitted in ICU. This is consistent with other studies as higher leukocyte count predicts severe disease.[22,23] Same is true for other inflammatory markers, liver, and renal profile. In the current study, higher mean values were found in the critical patients.

The most common complications in our study group were pneumonia and respiratory failure as this infection most commonly damages the walls and lining of air sacs of the lungs.[24,25] Thirty percent of the patients developed ARDS. AKI is also quite commonly seen in these patients. Our study also strengthens this observation. Despite of near normal values of initial renal function tests, 23% of the patients developed AKI. Therefore, this finding highlights the importance of fluid resuscitation in these patients.[26]

Among the inflammatory markers, significant differences were observed in WBCs, Hb, lymphocytes, platelets, CRP, ferritin, and D-Dimers between patients in ward and ICU which is consistent with the findings reported by Ahmad et al.[27] CRP is an exquisitely sensitive systemic marker of acute-phase response in inflammation, infection, and tissue damage, which could be used as indicator of inflammation. The present study shows that it is significantly raised in ICU patients. A study by Chen at al.[18] showed contrary results but majority of studies related elevated CRP levels with the disease severity.[27,28] These markers can help in triaging the patients for ICU in our clinical practice. Serum ferritin is also an important inflammatory marker which is significantly high in critical patients.

Conclusion

COVID-19 disease has a wide range of symptoms but respiratory system is involved most frequently. Laboratory derangements predict severity in these patients especially the inflammatory markers.

Limitations of the study

The data shared is from one clinical center. The number of enrolled patients is small sample considering the expanding prevalence of the disease. We had to exclude the patients with incomplete data as it was a retrospective study.

List of Abbreviations

AKI	Acute kidney injury
ALT	Alanine aminotransferase
ARDS	Acute respiratory distress syndrome
AST	Aspartate aminotransferase
CRP	C-reactive protein
Hb	Heamoglobin
ICU	Intensive care unit

LDH Lactate dehydrogenase
SpO_2 Oxygen saturation
SPSS Statistical Package for the Social Sciences

Conflict of interest
None to declare.

Grant support and financial disclosure
None to disclose.

Ethical approval
The Ethical approval was granted by Ethics Committee/Institutional Review Board/Research Committee, Postgraduate Medical Institute/Ameer ud Din Medical College & Lahore General Hospital, Lahore, Pakistan. (Reference No. 00-125-20 dated 20/07/2020).

Authors' contributions
HB and AK: Conception and design of the study, critical analysis with intellectual input, analysis and interpretation of data.
SA and AH: Analysis and interpretation of data.
KW, MAN, and MJ: Acquisition of data, drafting the manuscript, conception, and design of the study.
ALL AUTHORS: Approved the final version of the manuscript to be published.

Authors' details
Huma Batool[1], Asifa Karamat[2], Khalid Waheed[3], Sohail Anwar[4], Syed Arslan Haider[5], Syed Mazhar Ali Naqvi[6], Munaza Javed[7]

1. Assistant Professor of Pulmonology, Lahore General Hospital, Lahore, Pakistan
2. Assistant Professor of Pulmonology, Department of Tuberculosis and Chest Medicine, Gulab Devi Hospital, Lahore, Pakistan
3. Professor of Pulmonology & Sleep Medicine, Lahore General Hospital, Lahore, Pakistan
4. Assistant Professor of Pulmonology, University of Lahore Teaching Hospital, Lahore, Pakistan
5. Assistant Professor of Neurology, PINS, Lahore General Hospital, Lahore, Pakistan
6. Associate Professor of Pulmonary and Critical Medicine/MICU, Services Hospital, Lahore, Pakistan
7. Associate Professor of Medicine, Azra Naheed Medical College, Lahore, Pakistan

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