Microbes and Infectious Diseases 2023; 4(2): 370-382

Microbes and Infectious Diseases

Journal homepage: https://mid.journals.ekb.eg/

Original article

Clinical and laboratory predictors of disease severity and outcome in COVID 19 infected patients in Suez Canal University Hospital, single center study from Egypt

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ARTICLE INFO

Article history:
Received 29 December 2022
Received in revised form 29 January 2023
Accepted 3 February 2023

Keywords:
COVID-19
Predictors
Severity
Outcome
Egypt

ABSTRACT

Background: The novel corona virus is a high contagious disease, declared by World Health Organization (WHO) as a global pandemic in 2020 with profound impact on morbidity and mortality, assessment of outcomes in infected patients and knowledge of prediction of mortality and morbidity are important. We aimed to assess the clinical and laboratory findings in predicting COVID-19 severity and outcome in patients admitted to Suez Canal University Teaching Hospital. **Methodology:** This cross-sectional prospective study included 500 confirmed PCR COVID-19 infected patients, selected through random sampling. A structured checklist was used to collect patient data. **Results:** Mean age was 61.8 years, 56.2% were males, 74.8% had comorbidities. Lung involvement was evident in more than 75% on CT, 17.2% had leukopenia, 42.2% had lymphocytopenia between 5 – 10% and 93% of the patients had elevated neutrophil- lymphocyte ratio. 65.8% had elevated D-dimer, and elevated liver and kidney functions were found in 40.6% and 25% respectively. The mortality rate in studied population was 30.2% and it was significantly associated with old age, hypoxemia, having high involvement of the lungs on CT. Decreased WBC count, high D-dimer level and high NLR associated with severity and increased death rate of the disease. **Conclusion:** The study revealed many findings with impact on the patient's severity and outcome old age, laboratory findings, CT imaging and need to antiviral therapy the most predicting factors of the severity and prognosis of the patient.

Introduction

Corona viruses are a group of viruses that have the ability to cause infectious diseases as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) [1]. In March 2020, the outbreak of COVID -19 was declared by the World Health Organization (WHO) as a pandemic. The virus has rabidly spread to 206 countries worldwide with high morbidity rate reaching more than 480 million cases, and high mortality rate reaching more than six million deaths reported globally [1]. Symptoms caused by these

DOI: 10.21608/MID.2023.184185.1441
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viral infections ranged from mild symptoms to severe illness. Infected patients may have symptoms within 2-14 days after exposure to the virus. From 2020 to 2021, the age-adjusted death rate in U.S increased by 0.7%, from 835.4 to 841.6 per 100,000 standard population. COVID-19 death rates were highest among persons aged ≥85 years, non-Hispanic Native Hawaiian and males [2]. In Egypt, according to WHO regular reports, there have been more than 505,264 confirmed cases of COVID-19 with 24,417 deaths.

The novel corona virus (SARS-CoV-2**)** is a new beta CoV that related to the same subgenus as the severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV). Both viruses can result in severe lower respiratory tract infection with acute respiratory distress syndrome and extra pulmonary manifestations such as diarrhea, lymphocytopenia, liver and renal functions derangements. SARS-CoV and MERS-CoV epidemics caused mortality (10-35%) in both immunocompetent and immunocompromised hosts respectively [3].

Respiratory droplets, air borne and fomite transmission are the common routes of transmission [4**]**. SARS-CoV-2 primarily targets the respiratory system, but it may also affect other important organ systems, including the gastrointestinal tract (GI), hepatobiliary, cardiovascular, renal, and central nervous system [5].

The predictors of the severity of the disease are not all well known, but it appears that primarily demographic, clinical, virological, immunologic, hematological, biochemical and radiographic findings correlate with COVID-19 disease severity and higher risk of mortality [6,7] The old age is a major predictor of mortality and it is thus considered a key factor in the severity scoring of the disease [6]. According studies, older individuals and those with long-standing medical issues are more likely to contract severe COVID-19, which can result in hospitalization, admission to intensive care, and death [6].

Laboratory predictors are commonly associated in identifying the progression of the disease [8]. As the disease worsened, it was noticed that several laboratory measurements, such as the serum viral load and the NLR, CRP, ferritin, IL-6, and IL-10 levels rise, as well as the lymphocyte count, declined [9].

Oxygen saturation (SpO2) of patients > 90.5% expected survival of affected patients with sensitivityof 84.6% and specificity of 97.2%, whereas dyspnea was independently associated with increased mortality rate. Image studies are beneficial in revealing the findings which are linked to the development and worsening of the disease [6,8].

Severe COVID-19 has been defined on clinical base as respiratory distress with increased respiratory rate more than 30/min, pulse oximeter oxygen saturation less than 93% at rest, and oxygenation index (artery partial pressure of oxygen/inspired oxygen fraction, PaO2/FiO2) less than 300 mm Hg. Critically ill disease was described as respiratory failure requiring mechanical ventilation, shock, or other organ failure requiring intensive care unit (ICU) admission [10]. Results from a European multicenter prospective cohort study, which conducted about four thousand critically ill infected patients with COVID-19, reported a 90-day mortality of about 31%, with higher mortality noted in elderly, diabetic, obese, and severe ARDS patients.

Our aim of this conducted study was to explore the role of the clinical, laboratory and imaging data, of COVID-19 patients admitted to hospital, on disease progression and mortality. Evidence from this study may be useful to public health officials to plan possible interventional measures.

Patients and methods

This cross-sectional prospective study included five hundred patients with confirmed COVID-19 admitted to COVID-care-unit at Suez Canal University Teaching Hospital, Ismailia, Egypt. All were confirmed positive by PCR for their nasal swab during 2021. At the time of study, the practice guidelines in Egypt had admitted confirmed COVID-19 cases with moderate or severe illness to hospital while mild cases were treated and isolated at home. All patients of both sexes were eligible for participation and selection was done by random sampling. A structured checklist was used to collect sociodemographic parameters, clinical, laboratory and imaging data of the disease as well as diseases progression and deaths. The study excluded patients who refused to participate or had negative PCR on admission.

Ethical approval

Ethical approval was done by the Suez Canal University, Faculty of Medicine Ethical Committee (IRB number 4543#). The title, aim and the benefits of the study were explained for each subject, and, after approval, an informed consent was obtained from each subject.

Statistical analysis

Statistical analysis was performed using statistical package for social science SPSS-23 software (SPSS, Chicago, IL, USA). Quantitative data was described in terms of range and mean (±SD), while nonnumeric data were described as frequencies and percentages. Comparison of groups was based on independent t test and Chi-square test. A value of *p*-value <0.05 was considered statistically significant.

Results

Table 1, the mean age of the studied 500 patients was 61.87 ± 14.07 years, 56.2% were males, 73.6 % were from urban areas, 37.4% were smokers and 76.8% had comorbidities .

Table 2, in this study about the half of patients had history of exposure to confirmed COVID-19 patients , 30.8% of patients presented to hospital with combined symptoms (more than one symptom) followed with dyspnea (24.2),cough (23.2%) and GIT symptoms presented only in 5.8***%***, most patient delayed in presentation to hospital ((51.0)presented after 10 days of beginning of symptoms and 12.6 % presented within 3-9 days and only 36.4 % presented early within 3 days of beginning of symptoms ,most of patients were hypoxic at presentation (89.4***%***),about 90 % of patients need oxygen therapy during admission ,100% of patents received steroid therapy ,anticoagulant therapy used in 94.4 % of patients and 74.2 % of patients received specific anti-viral therapy.

Table 3, in this study, 38.6% of the patients, COVID affected > 50% of both lungs on CT. Laboratory findings revealed leukopenia in 17.2% of patients, lymphopenia in 94.8 %; being severe (between 5-10%) in 42.2%. Moreover, about 93% of the patients had elevated neutrophil-lymphocyte ratio (NLR). Elevated D-Dimer, CRP and ferritin was found in 65.8%, 100% and 84.8***%***. Elevated ALT and creatinine were reported in 40.6% and 25% of the patients, respectively.

Table 4 showed the invasive respiratory support (C-PAP and intubation) was significantly higher in dead patients otherwise history of exposure to confirmed cases, presenting symptoms ,duration of symptoms before admission and need for oxygen support were not significantly different between tow groups.

Table 5, during the study, 151 ***(***30.2%) of the cases died. **Table 5** shows that deceased COVID-19 patients had statistically higher mean age (67.51 ± 11.908) compared to those who survived (60.69 ± 14.212) (p<0.001). Smoking and comorbid illnesses were more frequent among deceased compared to survivors but with no significant differences (p=0.39 and 0.2 respectively). However, the odds ratio of mortality among patients with comorbid illness and smokers was 2.28 (95% CI: 1.27-4.12) and 1.25 (95% CI:0.78-2.01).

Table 6 shows that mortality rate among confirmed PCR COVID-19 patients was statistically significant associated with higher percentage of lung affection on CT chest (p<0.001), abnormal WBC count (p=0.005) abnormal lymphocyte count and higher D-dimer (p<0.001).

The OR of death among patients with serum D-Dimer>0.4 mcg/mL and high neutrophil to lymphocytes ratio was 3.44 (9% CI: 1.58-6.42) and 3.76 (95% CI: 0.89-15.95), p<0.001 and 0.07, respectively. The OR of death among patients with thrombocytopenia and lymphocyte level below 10% was 1.1 (95% CI:0.59-2.1) and 7.11 (95% CI: 4.12-12.27), p=0.73 and <0.001, respectively. The odds of mortality among patients with affection of more than 50% both lungs were 4.57 (95% CI:2.77-7.52), p<0.001). The likelihood of mortality among patients with leukopenia and leukocytosis was 1.5 (95% CI: 0.95-2.4), p=0.083.

Table 7, in this study, by logistic regression analysis, the age (==0.002), need of antiviral therapy (p=0.02), involvement of 50-75% (p=0.02) of the lungs by the disease, and D-Dimer >0.4 mcg/mL (p=0.01) were independent predictors of mortality, shows logistic regression analysis was used to assess the predictors of death among studied sample. It was found that the odds of death among COVID-19 patients increases with age (p=0.002), with CT chest affection more than 75%, being in need to antiviral treatment and having D-dimer more than 0.4 mcg/mL(p=0.001).

Table 1. Baseline characteristics of the patients.

Variables	**n= 500**
Age (years), mean ± SD	61.87 ± 14.07
Gender	
Male	281 (56.2)
Female	219 (43.8)
Residency	
Urban	368 (73.6)
Rural	132(26.4)
Education, n (%)	
Not educated	59 (11.8)
Educated	441 (88.2)
Smoking	
Absent	313 (62.6)
Present	187 (37.4)
Comorbidities	
Absent	116 (23.2)
Present	384 (76.8)
Cardiac disease	100 (20)
Diabetes	63 (12.6)
Renal disease	27 (5.5)
Respiratory disease	25 (5)
Chronic liver disease	17 (3.4)
multiple comorbidities	152 (30.4)

Table 2. The clinical parameters of study population.

Exposure to positive PCR patients	No	242 (48.4)
	Yes	258 (51.6)
Main patient symptoms	General, malaise, fatigue	17 (3.4)
	Fever	63 (12.6)
	Dyspnea	121 (24.2)
	GIT symptoms	29 (5.8)
	Cough	116 (23.2)
	Combined	154 (30.8)
Duration of symptoms	1 – 3 days	182 (36.4)
	4 – 9 days	63 (12.6)
	> 10 days	255 (51.0)
O2 status at admission	Normal	53 (10.6)
	Hypoxic	447 (89.4)
Type of O2 therapy needed during admission	No need	51 (10.2)
	Nasal	113 (22.6)
	Mask	107 (21.4)
	Venturi mask	81 (16.2)
	Mask reservoir	57 (11.4)
	C-pap	43 (8.6)
	Intubated	48 (9.6)
Received antiviral(remdesivir)		371 (74.2)
Received corticosteroids		500 (100)
Received anticoagulants therapy		472 (94.4)

Table 3. Laboratory and radiological characteristics of the participants.

Variables	**n= 500**
Percentage of CT chest radiograph affection	
< 30%	141 (28.2)
30 – 50%	166 (33.2)
50 – 75%	135 (27)
> 75%	58 (11.6)
White blood cells count	
<4.000	86(17.2)
4.000 – 11.0000	275 (55)
> 11.000	139 (27.8)
Lymphocyte count	
<20%	474(94.8)
20 – 45%	16 (3.2)
> 45%	10 (2)
Percentage of low lymphocyte (n=474)	
<5%	121(24.2)
5-10%	211(42.2)
10-15%	90(18)
15 - 20 %	52 (10.4)
Neutrophil-Lymphocyte Ratio (NLR)	
Normal	36 (7.2)
Increased	464 (92.8)
Platelet count	
<150,000	74(14.8)
150,000 – 450,000	426 (85.2)
D-dimer	
< 0.4	171 (34.2)
> 0.4	329 (65.8)
CRP level	
<10	2 (0.4)
> 10	498 (99.6)
Ferritin level	
150 – 300	76 (15.2)
> 300	424 (84.8)
Elevated liver enzymes	
No	297 (59.4)
Yes	203 (40.6)
Elevated serum creatinine	
Yes	125 (25.0)
No	375(75.0)

Table 4. Association between outcome of the patients and their clinical data of the patients.

Clinical data		**Outcome**			***p*-value**
		Discharge (349)	**Died (151)**	**Total**	
Exposure to positive PCR patients	No	170 (34.0)	72 (14.4)	242(48.4)	0.846
	Yes	179(35.8)	79(15.8)	258 (51.6)	
main symptoms	Fatigue, Body ache	16(4.6)	4(2.6)	20(4.0)	0.235
	Fever	42(12.0)	21(13.9)	63(12.6)	
	Dyspnea	82(23.5)	36(23.8)	118(23.6)	
	headache	22(6.3)	7(4.6)	29(5.8)	
	Cough	86(24.6)	31(20.5)	117(23.4)	
	Combined	101(28.9)	52(34.4)	153(30.6)	
Durations of symptoms	1 – 3 days	124 (35.5)	58 (38.4)	182 (36.4)	0.454
	4 – 9 days	41(11.8)	22 (14.6)	63(12.6)	
	> 10 days	184 (52.7)	71 (47.0)	255 (51.0)	
Need oxygen support	yes	308(88.3)	140(92.7)	448(89.6)	0.152
	No	41(11.7)	11(7.3)	52(10.4)	
type of oxygen support	No need	40(11.5)	11(7.3)	51(10.2)	.000
	Nasal canula	102(29.2)	10(6.6)	112(22.4)	
	Nasal mask	92(26.4)	15(9.9)	107(21.4)	
	Venture mask	63(18.1)	18(11.9)	81(16.2)	
	Mask reservoir	36(10.3)	21(13.9)	57(11.4)	
	C-PAP	9(2.6)	34(22.5)	43(8.6)	
	Intubation	6(1.7)	42(27.8)	48(9.6)	

Table 5. Association between outcome of the patients and their baseline characteristics of the patients.

		Outcome		**Total**	
		Discharge 349	**Died 151**		
Age		60.69 ± 14.212	67.51 ± 11.908		<0.001*[a]
Sex	Male	187 (53.6)	94(62.3)	281(56.2)	0.078
	Female	162(46.4)	57(37.7)	219(43.8)	
Education	No	37 (10.6)	22 (14.6)	59 (11.8)	0.228
	yes	312 (89.4)	129 (85.4)	441 (88,2)	
Residency	Urban	258(73.9)	110(72.8)	368(73.6)	0.825
	Rural	91(26.1)	41(27.2)	132(26.4)	
Smoking	yes	126(36.1)	61(40.4)	187(37.4)	0.367
	No	223(63.9)	90(59.6)	313(62.6)	
Comorbidity	N0	86(24.6)	31(20.5)	117(20.5)	0.2
	cardiac	68(19.5)	32(21.2)	100(20.0)	
	DM	43(12.3)	20(13.2)	63(12.6)	
	Chest disease	16(4.6)	9(6.0)	25(5.0)	
	Renal	20(5.7)	6(4.0)	26(5.2)	
	Combined	79(22.6)	34(22.5)	113(22.6)	
	CLD	10(2.9)	7(4.6)	17(3.4)	
	Others	27(7.7)	12(7.9)	39(7.8)	

Table 6. Association between outcome of the patients and their radiological and laboratory characteristics of the patients.

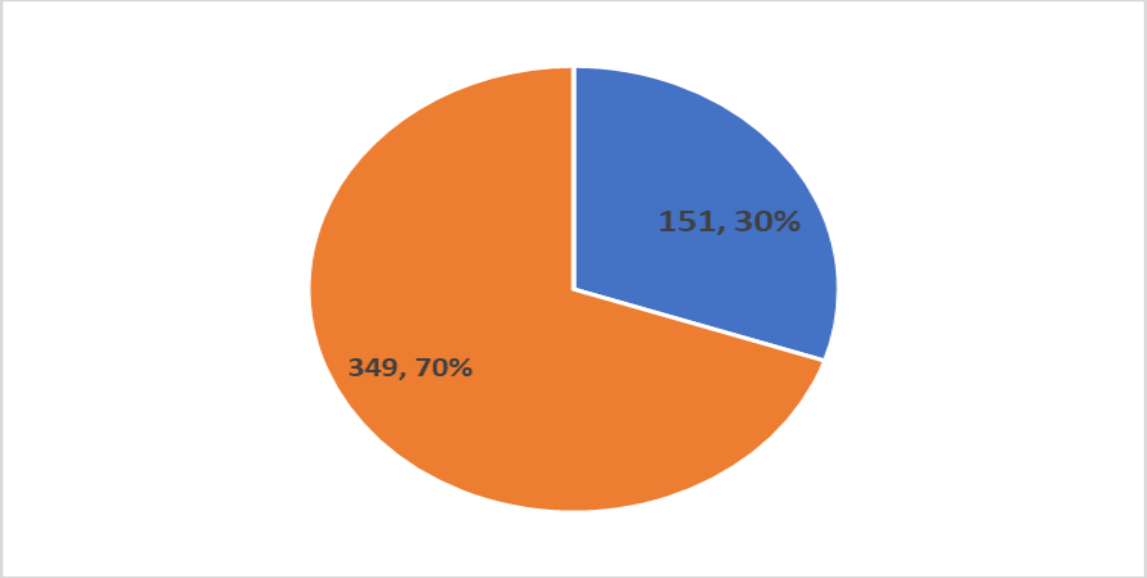
		Outcome			
		Discharge	**Died**	**Total**	
Percentage of CT involvement	<30	120(34.4)	21(13.9)	141(28.2)	0.000
	30-50	131(37.5)	35(23.2)	166(33.2)	
	50-75	78(22.3)	57(37.7)	135(27)	
	>75	20(5.7)	38(25.2)	58(11.6)	
WBC	4000-11000	206(59.0)	69(45.7)	275(55.0)	0.003
	<4000	58(16.6)	28(18.5)	86(17.2)	
	>11000	85(24.4)	54(35.8)	139(27.8)	
Lymphocyte	20 – 45	14(4.0)	2(1.3)	16(3.2)	0.018
	< 20	328(94.0)	149(98.7)	477(95.4)	
	>45	7(2.0)	0(0.0)	7(1.4)	
The percentage of low lymphocyte	>20	22(6.3)	4(2.6)	26(5.2)	0.001
	15-20	40(11.5)	12(7.9)	52(10.4)	
	10-15	70(20.1)	20(13.2)	90(18.0)	
	5-10	150(43.0)	61(40.4)	211(42.2)	
	<5	67(19.2)	54(35.8)	121(24.2)	
NLR	Normal	28(8.0)	8(5.3%)	36(7.2)	0.348
	Increased	321(92.0)	143(94.7)	464(92.8)	
Platelet count	Normal	302(86.5)	124(82.1)	426(85.2)	0.218
	Decreased	47(13.5)	27(17.3)	74(14.8)	
D Dimer	Norma	200(57.3)	110(72.8)	310(62.0)	0.001
	Increased	149(42.7)	41(27.2)	190(38.0)	
Ferritin level	150-300	59(16.9)	17(11.3)	76(15.2)	0.135
	>300	290(83.1)	134(88.7)	424(84.8)	
Elevation of liver enzymes	yes	140(40.1)	63(41.7)	203(40.6)	0.766
	No	209(59.9)	88(85.3)	297(59.4)	
Elevation of kidney functions		80(22.9)	45(29.8)	125(25.0)	0.115
		269(77.1)	106(70.2)	375(75.0)	

Table 7. Logistic regression analysis of determinants of death among studied sample.

Variables	*β*	(SE)	OR (95% CI)	p-value
Constant	-1.676	0.806	-	**0.037***
Age	0.035	0.011	1.036(1.013 – 1.059)	**0.002***
O_2 saturation at admission				
Hypoxic	-0.092	0.599	0.912 (0.282 – 2.9522)	0.878
Need for antiviral therapy				
Yes	1.044	0.449	2.842 (1.178 – 6.854)	**0.02***
Percentage of CT chest radiograph affection				
< 30%	-	-		.000
30 – 50%	-0.001	0.431	0.999 (0.429 – 2.35)	0.997
50 – 75%	0.922	0.397	2.515 (1.15 – 5.47)	**0.02***
> 75%	2.001	0.444	7.395 (3.09 – 17.64)	**<0.001***
White blood cells count				
4.000 – 11.0000	-	-		.049
< 4.000	-0.355	0.404	0.701 (0.318 – 1.549)	0.380
> 11.000	0.546	0.286	1.726 (0.985 – 3.024)	0.056
D-dimer				
> 0.4	0.897	0.347	2.453 (1.243 – 4.837)	**0.01***

* Statistical significance < 0.05.

Figure 1. The mortality rate among positive patients admitted to SCU Hospital over one year from last June 2020 is 30 %, while survivors formed about 70 % of the studied sample.



Discussion

This cross-sectional study of confirmed PCR COVID 19 infected patients with moderate to severe infections according to guidelines, who were admitted at Suez Canal University Teaching Hospital. It was designed to determine the clinical and laboratory findings in predicting the disease severity and outcome in COVID 19 patients.

Our study revealed that the mean age of the patients was 61.87±14.07 years and about 56.2 % of the sample was males. About 73.6 % of the sample came from urban areas. Moreover, 37.4% of the patients were smokers and 76.8% had comorbidities most of them (30.4%) had multiple comorbidities followed with cardiac disease (20%), but these comorbidities surprisingly not affect the outcome this might be explained by the large number of patients included in this study with comorbidities (76.8) in survivor and non survivors(75.4 % ; 79.5%) respectively and due to the admission criteria of guidelines during the period of data collection also, this finding surprisingly opposed the most other research results by other researchers as **Gallo marine et al.** [6] and **Muhammad et al.** who showed HTN,CKD and CAD was significantly common on non survivors patient [11]. In comparison to a study which was performed by **Huang et al.** revealed that the median age of the studied patients was 47 years; 58. 1% of the patients were males [12]. In another study performed by **Ahmed et al.** retrieved that COVID-19 death rates were highest among people whose age ≥85 years, non-Hispanic Native Hawaiian and males [2]**.**

Another study by **Jain et al.** revealed that hypertension (42.9 %) and coronary heart diseases (9.1%) were common comorbidities and were associated with COVID-19 severity [13].

In our study, we found about 53.8% of the patients had exposed to confirmed or suspected COVID-19 patient. At presentation, the most frequent main patient symptoms and complains were dyspnea (24%), cough (23.4%) and fever (12.6%). Moreover, about 90% of the patients were hypoxic where 22.6% of the hypoxic patients were on nasal oxygen support while only 9.6% had been intubated.

On other hand, **Wang et al.** [14] found the most common symptoms at onset of illness were rise in body temperature (136 [98.6%]), easy fatigability (96 [69.6%]), dry cough (82[59.4%]), muscle ache (48 [34.8%]), and shortness of breath (43 [31.2%]), this difference might be explained with including mild to moderate severity in his study also due to late presentation of our patients to the hospital where about 255 (51.0 %) of our patients presented to ER after 10 days of the beginning of symptoms. Less common symptoms were headache, dizziness, pain in abdomen, diarrhea, nausea, and vomiting. A total of 14 patients (10.1%) at the start presented with loss stool and nausea 1 to 2 days prior to development of rise in body temperature and difficult breathing [14]**.** This can be due to the culture of Egyptian patients in two main reason: the symptomatic person doesn't seek medical advice unless in late stages which is manifested mainly by severe dyspnea or hypoxia, in addition to the

medical protocol which permit admission to the severe cases only that may be due to the large number of affected patients which classify diseased ones based on their the highest need for hospitalization and our study included COVID -19 infected patients with moderate to severe infections and excluded mild cases with home isolation .

Two studies by **Song et al.** and **Chan et al.** included all COVID-19 infected patients with different grades of severity showed the different pattern of signs and symptoms found the common symptoms of fever (36,99%), easy fatigability (96,70%),and dry cough (82,59%), though there were two patients who did not present any signs of fever at the start of their illness. A higher proportion of cases presented with gastrointestinal symptoms including diarrhea and nausea (14, 10%) [15]**.**

Wu et al. found difficult breathing was found in 30.82 % of the included patients, and it is generally associated with worsening of their condition. On physical assessment, patients in severe condition present, in addition to dyspnea, increased respiratory rate, speech tremor, weakened breath sounds, and dullness on lung percussion [16]. Our findings showed radiological and laboratory measures of the studied patients. About 38.6 % of the patients had chest affection more than 50 % on CT Chest. Meanwhile, blood measures showed that 17.2% of the patients had low WBC count. Moreover, about 94.8 % had lymphocytopenia and 42.2% had severe lymphocytopenia between 5 – 10%. Moreover, about 93% of the patients had elevated neutrophil- lymphocyte ratio (NLR).

In addition to, about 65.8% patients had elevated D-dimer and all patients had high CPR level. Elevated liver and serum creatinine were reported in 40.6% and 25% of the patients, respectively.

In the study of **Jiang et al.** noticed the patients with COVID-19 presented more laboratory abnormalities, including thrombocytopenia, lymphocytopenia and raised serum levels CRP, liver transaminase, myocardial enzymes, creatinine, and D- dimer levels [17], and this results matched with our findings **.**

Although in our study 84.8 *%* of study populations had high ferritin level ,but no significant difference between died and alive patient (p=0.247) and this on the contrary of other studies as in Muhammad et al study who revealed ferritin level was significantly higher in non-survivor patients [11].

In another study matched with our findings, **Wang et al.** lymphocytopenia occurred in about ninety-seven patients (70.3%), prolonged prothrombin time in eighty patients (58%), and elevated lactate dehydrogenase in fifty-five patients (39.9%). Chest computed tomographic scans showed bilateral patchy shadows or ground glass opacity in the lungs of all patients [14].

In **Wang et al.** study**,** showed the neutrophil count, D-dimer, blood urea, and creatinine levels continued to increase, and the lymphocyte counts continued to decrease until death occurred. Neutrophilia may be related to cytokine storm induced by virus invasion, secondary bacterial infections , coagulation activation could have been related to sustained inflammatoryresponse,andacutekidneyinjurycouldh avebeenrelatedtodirect effects of the virus, hypoxia, and shock [14]**.**

In this cross-sectional study of patients with COVID-19 showed that the COVID-19 patients who died had statistically significant higher age (67.51 ± 11.908) compared to those who survived (60.69 ± 14.212) (p<0.001). Otherwise, there was no statistically significant association between death and the baseline characteristics of the participants.

Also , **Halmaciu et al.** found old age was independent predictor factor for mortality in severely infected patients [18], and this results was matched with our study results.

In another study by **Gallo Marin et al.** revealed that older age is the main predictor of mortality in SARS -Cov2 infected patients and this results support our findings [6].

In **Auld et al.** study, found that mortality increased with older people, with 42.5% mortality in those age 65 and above as compared with 11.3% in those younger than fifty-five. Mortality was also increased with severity of illness on arrival to the ICU and need for ICU interventions including mechanical ventilation, vasopressor support, and renal replacement therapy[19].

In this study the sex of patients was not statistically significant different between two groups (p=0.284 **,)** so it's not independent predictor for mortality or severity, also **Gallo Marin et al.** mentioned in there review that male sex is not associated with SARS-Cov2 severity [6].

About the logistic regression analysis that was used to assess the predictors of death among studied sample. It was found that the odds of death among COVID-19 patients increases with age (p=0.02), being in need to antiviral treatment and having D-dimer more than 0.4 mcg/mL (p=0.01).

In our study showed significantly higher levels of death positive COVID-19 patients associated with hypoxic patients (p<0.045), intubation (p<0.001) and being in need to antiviral therapy (p<0.01).

Moreover, our results found the death among of COVID-19 patients were statistically significant associated with higher percentage of lung affection on CT chest (p<0.001), abnormal WBC count (p=0.005) and higher D- dimer (p<0.01).

In another study support our results carried out with Muhammad et al revealed that patient who died has higher D-dimer levels than alive patients [11].

Also, **Halmaciu et al.** observed that mortality in severely infected patients significantly increased in patient with high lung parenchymatous involvement [18], and this results was matched with our study results .

In a comparison to **Arentz et al.** this study represents the first description of critically ill patients infected with SARS-CoV-2 in the US. These patients had a high rate of ARDS and a high risk of death and mortality rates among those admitted to ICUs are 71% [20].

Grasselli et al. showed most patients in this case series were admitted to the ICUs because of acute hypoxemic respiratory failure that required respiratory support. Endotracheal intubation and invasive mechanical ventilation were needed in 88% of the patients, whereas only11% could be managed with non invasive ventilation [21].

Zhou et al. In some of the earliest reports of COVID-19 The mortality rates among those hospitalized and admitted to ICUs ranged from 52% to 62% and increased up to 86–97% among those requiring invasive mechanical ventilation [10].

In summary, old age, high resolution CT Chest affection, abnormal WBCs, severe lymphocytopenia, higher D-dimer levels and hypoxia, in addition to being in need to antiviral therapy are good predictors for the severity and outcome of the COVID-19 infected patients.

Study limitation

The study was conducted in one hospital, study included only moderately to severely infected patients and no mild cases were included.

Conclusion

According to our findings in single hospital-based study over one year from last June 2020 is about 30%, while survivors formed about 70 % of the sample, old age, high lung parenchymatous involvement and need to specific antivirus treatment were independent predictors of mortality in moderate to severely COVID -19 infected patients admitted to SCU hospital at the study time.

Acknowledgement

We would like to thank our professor, Dr. Mostafa Mohamed Raghib, for his encouragement and assistance with this paper's planning, writing, and editing.

Conflict of interest

The authors report no conflicts of interest.

Financial disclosures

All the fund of this research was covered with research team and no external funds were received.

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