Original Article

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TANAFFOS

Clinical Presentations of the Survivor and Non-survivor Hospitalized Patients with COVID-19 in the Golestan Province of Iran during the First Peak of the Epidemics

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Background: Considering the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) pandemic, which causes coronavirus disease 2019 (COVID-19), we aimed to report the clinical features of 427 patients with COVID-19 and the outcomes after one-month admission to major teaching hospitals in the northeast of Iran.

Materials and Methods: Data of patients hospitalized with COVID-19 from 20 February 2020 to 20 April 2020 was analyzed using the R software. The cases and their outcomes were monitored up to one month following their admission.

Results: Among 427 patients with a median age of 53 years (50.8% male), 81 (19%) were directly admitted to the ICU ward, and 68 (16%) died during the study. The mean (SD) lengths of hospital stay were significantly higher in the non-survivors (6 (9) days) than survivors (4 (5) days) (P = 0.018). Ventilation need was reported in 67.6% of the non-survivors and 0.8% of the survivors (P < 0.001). Cough (72.8%), fever (69.3%), and dyspnea (64.0%) were the most common symptoms. There were more comorbidities in the severe cases (73.5%) and non-survivor (77.5%). Liver and kidney damage were significantly more common in non-survivors. Ninety percent of the patients had at least one abnormal chest CT scan finding, including crazy paving and consolidation patterns (27.1%), followed by the ground-glass opacity (24.7%).

Conclusion: Results showed that the patients' age, underlying comorbidities, levels of SpO_2, and laboratory findings at the time of admission may predict the progress of the disease and can be considered mortality-related factors.

Key words: COVID-19; Hospitalization; Imaging; Outcome; SARS-CoV-2

INTRODUCTION

Recently, our planet has faced a rapidly spreading lethal infectious disease named coronavirus disease 2019 (COVID-19). The causative agent is the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), a virus belonging to the Betacoronavirus family. Chinese

clinicians reported the first cases of unknown pneumonia in December 2019 in Wuhan, China. In the beginning, the evidence showed that this outbreak was associated with exposure to dead animals in a seafood market in Wuhan City (1,2). The disease then spread rapidly and was reported in Thailand, Japan, and the Republic of Korea (3). The World Health Organization (WHO) declared the COVID-19 pandemic on the 11th of March, 2020, three months after identifying the first cases (4).

After Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), COVID-19 is the third most important zoonotic coronavirus disease (5). Similar to SARS and MERS, COVID-19 affects the lower respiratory system and causes a respiratory disease, which principally presents with fever and pneumonia. This disease can present with a wide range of clinical features, from asymptomatic infection to mild and severe forms. It can even lead to acute respiratory distress syndrome (ARDS) and death. Although COVID-19 has more sluggish progress in the human body and causes milder lung damage compared to SARS and MERS, it is of more concern today because of the health and economic challenges it imposes. At first, its fatality rate was calculated around 2-3% (6), which was lower compared to SARS (9.6%) and MERS (35%). However, due to its high transmission rate, this virus is associated with higher mortality rates than SARS and MERS. Recently, this mortality rate has increased to more than 6% (5,7,8).

Several descriptive studies from different regions of the world, mainly China, reported diverse clinical presentations and outcomes of the disease. The most common clinical manifestations of COVID-19 are fever, dry cough, fatigue, and myalgia. These symptoms are similar to SARS and MERS, but there are considerable differences, such as gastrointestinal presentations, more severe upper respiratory tract symptoms, and more common afebrile disease (1,2). Therefore, early identification and timely management of patients with COVID-19 is critical. In short, a patient with a history of exposure to the virus or suggestive symptoms such as fever and respiratory symptoms should be investigated for the disease. Reverse transcription-polymerase chain reaction (RT-PCR) is a standard confirmation test for COVID-19. Computed tomography (CT) scan is another important diagnostic measure that is fast and usually available, and it can be of great use in the early identification of suspected cases (9, 10).

Similar to the United States of America (USA), Brazil, India, Russia, the United Kingdom (UK), France, Spain, Italy, and China, Iran has been among the countries with high COVID-19 prevalence and mortality rates. However, even after several months of the epidemic in Iran, little epidemiological and clinical information has emerged from our country. On a global scale, updated information about patients with COVID-19 in different geographical areas can significantly assist physicians and health policy-makers. Therefore, this descriptive study aimed to report clinical, laboratory, and imaging findings of 427 patients with COVID-19. The patients were all admitted to top teaching hospitals in the Golestan province, North East of Iran.

MATERIALS AND METHODS

Ethics

In this study, patients with COVID-19 were included according to the WHO interim guideline for diagnosing the disease (11). The University of Medical Sciences ethics committee approved the study (IR.GOUMS.REC.1398.383). Informed consent was obtained from all patients or their guardians. All authors reviewed and approved the final draft of the manuscript.

Study design

Selection and Description of the Participants

In this cross-sectional descriptive study, data from patients hospitalized in two referral COVID-19 centers in the province from 24 February 2020 and 20 April 2020 was compiled and analyzed. The data were extracted from an electronic medical record system known as Health Information System (HIS). Patients were assigned an identification number, therefore, the extracted data was anonymous. If patients' information in the system was

incomplete or unreliable, we obtained the data by reviewing their medical files or contacting their families by phone. Before receiving the patients' information in this case, their signed informed consent was sought. The primary endpoint outcomes were death or discharge from the hospital during the study period. Data from the first admission was recorded and analyzed if a patient had a hospital readmission history.

The collected data included demographic characteristics, clinical presentations, medical history, comorbidities, laboratory findings, management protocols, and outcomes. This information was evaluated and confirmed by two physicians independently. Moreover, two radiologists sighted the patients' chest CT scans and commented on the severity and patterns of lung involvement according to the protocol (12). Significant disagreements between the two experts were resolved by a third clinician. Tables 1 and 2 tabulate the details of the collected data. Laboratory findings included complete blood count, coagulation tests, blood chemical analysis, C-reactive protein (CRP), lactate dehydrogenase (LDH), liver and renal function tests, and the concentrations of electrolytes.

Table 1. Demographic and clinical characteristics of the enrolled COVID-19 patients

Characteristic	All Patients (N = 427)	Disease severity		P value	outcome of cases		P value
		Non-severe (N= 303)	Severe (N= 124)		Survivor (N = 259)	Non-survivor (N = 68)	
Age							
Median (IQR[1]) — year	53 (20)	50 (18)	61·5 (18)	< 0·001	51·00 (18)	61·50 (16)	< 0·001
Distribution — no./total no. (%)							
18 - 40	77/427 (18)	69/303 (22·8)	8/124 (6·5)		54/259 (20·8)	3/68 (4·4)	
40 - 60	206/427 (48·2)	159/303(52·5)	47/124 (37·9)	< 0·001	136/259 (52·5)	27/68 (36·7)	< 0·001
≥ 60	144/427 (33·7)	75/303(24·8)	69/124 (55·6)		69/259 (26·6)	38/68 (55·9)	
Female sex — no./total no. (%)	210/427 (49·2)	148/303(48·8)	69/124 (55·6)	0·202	120/259 (46·3)	26/68 (38·2)	0·232
Male sex — no./total no. (%)	217/427 (50·8)	155/303 (51·2)	55/124 (44·4)		139/259 (53·7)	42/68 (61·8)	
Admission to intensive care unit - no./total no. (%)	81/427 (19)	39/303 (12·9)	42/124 (33·9)	< 0·001	25/259 (9·7)	38/68 (55·9)	< 0·001
BMI — Median (IQR)	28·1 (5·7)	28·1 (6·5)	28·6 (5·1)	0·763	28 (6·1)	28·7 (3·6)	0·714
***Symptoms* — no./total no. (%)**							
Dyspnea	213/333 (64·0)	161/252 (63·9)	52/83 (64·2)	0·960	143/223 (64·1)	22/39 (56·4)	0·357
Fever	239/345 (69·3)	194/262 (74·0)	45/83 (54·2)	0·001	170/232 (73·3)	17/40 (42·5)	< 0·001
Cough	292/401 (72·8)	200/283 (70·7)	92/118 (78·0)	0·135	176/248 (71·0)	43/64 (67·2)	0·072
Low consciousness	11/331 (3·3)	7/251 (2·8)	4/80 (5·0)	0·337	8/221 (3·6)	3/39 (7·7)	0·244
musculoskeletal pain	173/352 (49·1)	137/265 (51·7)	36/87 (41·4)	0·095	114/231 (49·4)	14/44 (31·8)	0·033
Diarrhea	67/336 (19·9)	57/255 (22·4)	10/81 (12·3)	0·050	44/224 (19·6)	3/39 (7·7)	0·072
Anosmia	49/331 (14·8)	44/251 (17·5)	5/80 (6·3)	0·013	35/221 (15·8)	1/39 (2·6)	0·027
Taste loss	43/331 (13·0)	38/251 (15·1)	5/80 (6·3)	0·039	29/221 (13·1)	0/39 (0)	0·011
Length of hospital stay —Median (IQR[1]) — days	4 (6)	3 (5)	5·5 (9)	< 0·001	4 (5)	6 (9)	0.018
Ventilation — no./total no. (%)	57/427 (13·3)	20/303 (6·6)	37/124 (29·8)	< 0·001	2/259 (0·8)	46/68 (67·6)	< 0·001
***Chronic medical illness* — no./total no. (%)**							
Any	195/333 (58·6)	134/250 (53·6)	61/83 (73·5)	0·001	124/222 (44·1)	31/40 (77·5)	0·010
Diabetes	90/331 (27·2)	56/250 (22·4)	34/81 (42·0)	0·001	56/221 (25·3)	18/39 (46·2)	0·008
Hypertension	86/333 (25·8)	52/251 (20·7)	34/82 (41·5)	< 0·001	57/222 (25·7)	14/40 (35·0)	0·222
Cardiovascular disease	64/331 (19·3)	36/250 (14·4)	28/81 (34·6)	< 0·001	37/221 (16·7)	10/39 (25·6)	0·183
Cerebrovascular diseases	7/331 (2·1)	2/251 (0·8)	5/80 (6·3)	0·003	1/221 (0·5)	4/39 (10·3)	< 0·001
Respiratory system disease (COPD[2])	39/332 (11·7)	23/251 (9·2)	16/81 (19·8)	0·010	23/221 (10·4)	8/40 (20·0)	0·084
Cancer	4/332 (1·2)	3/251 (1·2)	1/81 (1·2)	0·977	2/221 (0·9)	2/40 (5·0)	0·052
ESRD[3]	25/333 (7·5)	7/251 (2·8)	18/82 (22·0)	< 0·001	11/221 (5·0)	9/41 (22·0)	< 0·001

1: Interquartile range; 2: Chronic obstructive pulmonary disease; 3: End-stage renal disease; 4: Angiotensin-converting enzyme 2 inhibitor

Table 2. Radiographic and laboratory findings of COVID-19 patients

Variable	All patients (N= 427)	Disease severity		P value	Outcome of cases		P value
		Non-severe (N= 303)	Severe (N= 124)		Survivor (N= 259)	Non-survivor (N= 68)	
Laboratory findings							
Complete blood count							
Leucocytes (× 10^9 per L; normal range: 3·5-9·5); Median (IQR[1])	6·7 (4·2)	6·0 (3·6)	8·9 (5·6)	< 0·001	6·3 (4·0)	7·8 (6·4)	0·002
Lymphocytes (× 10^9 per L) — Median (IQR)	1·2 (0·7)	1·3 (0·7)	1·1 (0·7)	0·311	1·2 (0·7)	1·1 (0·6)	0·098
Neutrophils (× 10^9 per L) — Median (IQR)	4·8 (3·7)	4·2 (3·4)	6·8 (5·1)	< 0·001	4·6 (3·7)	6·4 (5·7)	0·005
Monocytes (× 10^9 per L) — Median (IQR)	0·16 (0·12)	0·16 (0·11)	0·18 (0·15)	0·004	0·16 (0·12)	0·14 (0·11)	0·311
Platelets (× 10^9 per L; normal range: 100-350); Median (IQR)	183·0 (82·0)	177·0 (75)	192·5 (101)	0·005	184·0 (77)	174·0 (106)	0·107
Coagulation function							
Partial Thromboplastin Time (s; normal range 21·0 - 37·0) — Median (IQR)	35·0 (13·0)	36·0 (11·0)	32·0 (13·0)	0·248	35·0 (10·5)	37·0 (13·0)	0·758
Prothrombin time (s; normal range 10·5–13·5) — Median (IQR)	13·2 (1·9)	13·1 (1·2)	13·6 (2·0)	0·357	13·1 (1·1)	14·0 (2·6)	0·011
***Blood chemistry* — no./total no. (%)**							
Albumin ≥ 5 g/dL	1/109 (0·9)	0/61 (0)	1/48 (2·1)	0·062	0/58 (0)	1/31 (3·2)	0·078
Albumin ≤ 3·5 g/dL	29/109 (26·6)	12/61 (19·7)	17/48 (35·4)		10/58 (17·2)	10/31 (32·3)	
C-reactive protein ≥ 3 mg/L	270/326 (82·8)	187/231 (81·0)	83/95 (87·4)	0·163	174/202 (86·1)	43/52 (82·7)	0·530
Lactate dehydrogenase ≥ 250 U/L	315/325 (96·9)	216/225 (96)	99/100 (99)	0·294	198/207 (95·7)	58/58 (100)	0·213
Alanine aminotransferase > 40 U/liter	61/186 (32·8)	40/124 (32·3)	21/62 (33·9)	0·825	43/121 (35·5)	11/33 (33·3)	0·814
Aspartate aminotransferase > 40 U/liter	74/185 (40)	41/124 (33·1)	33/61 (54·1)	0·006	43/120 (35·8)	18/33 (54·5)	0·052
Blood urea > 30 mg/dL	193/372 (51·9)	113/263 (43·0)	80/109 (73·4)	0·000	105/236 (44·5)	47/60 (78·3)	< 0·001
Serum creatinine > 1·2 mg/dL	113/372 (30·4)	66/263 (25·1)	47/109 (43·1)	0·001	62/236 (26·3)	31/60 (51·7)	< 0·001
Urea/creatinine ratio > 20	309/372 (83·1)	213/263 (81·0)	96/109 (88·1)	0·097	188/236 (79·7)	56/60 (93·3)	0·013
Creatine phosphokinase ≥ 200 U/liter	67/176 (38·1)	38/114 (33·3)	29/62 (46·8)	0·079	41/113 (36·3)	18/36 (50·0)	0·143
Glucose ≥ 200 mg/dL	69/348 (19·8)	39/244 (16·0)	30/104 (28·8)	0·006	36/215 (16·7)	19/59 (32·2)	0·009
Hypernatremia (Na+ ≥ 147 mmol/L)	3/269 (0·8)	1/260 (0·4)	2/109 (1·8)	< 0·001	1/233 (0·4)	2/61 (3·3)	< 0·001
Hyponatremia (Na+ ≤ 137 mmol/L)	115/369 (31·2)	66/260 (25·4)	49/109 (45·0)		62/233 (26·6)	31/61 (50·8)	
Hyperkalemia (K+ ≥ 5·3 mmol/L)	25/368 (5·9)	14/26 (5·4)	11/108 (10·2)	0·099	13/233 (5·6)	6/60 (10·0)	0·390
Hypokalemia (K+ ≤ 3·5 mmol/L)	19/368 (4·4)	11/260 (4·2)	8/108 (7·4)		11/233 (4·7)	3/60 (5·0)	
Radiologic findings — no./total no. (%)							
Normal chest CT scan	43/425 (10·1)	41/302 (13·6)	2/123 (1·6)	< 0·001	29/258 (11·2)	4/67 (6·0)	< 0·001
Abnormalities on chest CT scan (any)	382/425 (89·1)	261/302 (86·4)	121/123 (98·4)	< 0·001	229/228 (88·8)	63/67 (94·0)	0·203
Ground-glass opacity (GGO)	105/425 (24·7)	70/302 (23·2)	35/123 (28·5)		64/258 (24·8)	10/67 (14·9)	
Distortion	10/425 (2·4)	3/302 (1·0)	7/123 (5·7)		3/258 (1·2)	5/67 (7·5)	
Crazy Paving	88/425 (20·7)	61/302 (20·2)	27/123 (22·0)	< 0·001	50/258 (19·4)	22/67 (32·8)	0·004
Consolidation	64/425 (15·1)	52/302 (17·2)	12/123 (9·8)		37/258 (14·3)	7/67 (10·4)	
Crazy Paving & Consolidation	115/425 (27·1)	75/302 (24·8)	40/123 (32·5)		75/258 (29·1)	19/67 (28·4)	
Lung involvement							
0	42/426 (9·9)	38/303 (12·5)	4/123 (3·3)		27/259 (10·4)	5/67 (7·5)	
1-24	148/426 (34·7)	123/303 (40·6)	25/123 (20·3)		91/259 (35·1)	9/67 (13·4)	
25-49	126/426 (29·6)	90/303 (29·7)	36/123 (29·3)	< 0·001	77/259 ((29·7)	27/67 (40·3)	< 0·001
50-74	101/426 (23·7)	49/303 (16·2)	52/123 (42·3)		62/259 (23·9)	21/67 (31·3)	
≥ 75	9/426 (2·1)	3/303 (1·0)	6/123 (4·9)		2/259 (0·8)	5/67 (7·5)	

1: Interquartile range.

Based on the clinical conditions and the O_2 saturation (SpO_2) at the time of admission, patients were divided into two groups with severe and non-severe diseases. According to a protocol proposed by our expert physician, cases with SpO_2 less than 92% and an unstable hemodynamic status who needed ICU admission were considered severe (13).

Statistics

The patients' data were exported to an Excel (Microsoft Corp.) spreadsheet file from the HIS. Then they were imported into the R software, version 3.6.2 (R Foundation for Statistical Computing), and processed using Chi-Square, Fisher Exact, and Mann-Whitney U tests. Continuous variables were expressed as medians and interquartile ranges (IQR). Categorical variables were described as frequencies versus the available data (considering the missing data) and percentages. Laboratory results were also reported in numbers. The stacked bar chart and box plot was used to represent the differences between important statistical findings in both groups.

RESULTS

Demographic and clinical characteristics of patients

In this study on 427 COVID-19 cases with a median age of 53 (IQR = 20, range = 18-87 years old), all were older than 18 years, and 217 (50.8%) were male. The median age of the non-survivors was ten years greater than the survivors (61.5 vs. 51; p-value < 0.001). Most of the patients were between 40 and 60 years old (48.2%), but the severity of the disease and the number of deaths were higher in patients over 60 years (Table 1).

Although the female patients (55.6%) showed a higher rate of critically ill conditions than the male patients on admission, more deaths were seen in the male patients (61.8%). The fatality rate was 26.3% in patients older than 60 years. On admission, 303 (71%) patients had non-severe COVID-19, and 124 (29%) were in critical conditions. 81 (19%) out of 427 patients were initially admitted to the ICU. Moreover, on admission, SpO_2 levels were significantly lower in the patients who died.

Cough (72.8%), fever (69.3%), and dyspnea (64%) were the most common symptoms. Some unusual complaints were diarrhea (19.9%), anosmia (14.8%), and taste loss (13%). Anosmia and taste loss symptoms were often seen in non-severe cases. Among 333 patients with available underlying comorbidities information, 195 (58.6%) had at least one condition. Diabetes, hypertension, and end-stage renal disease (ESRD) were the comorbidities with the highest mortality rates.

Radiologic and Laboratory Findings

Table 2 shows the laboratory and CT scan findings of the patients with COVID-19 on admission. The two most noteworthy findings of the patients' blood count results were lymphopenia (227/333; 68.2%) and a sharp rise in neutrophils compared to lymphocytes in both groups. These changes were significant in the group with severe disease (p = < 0.001) and death outcomes. (p = 0.005)

Decreased level of albumin (26.6%) was another important finding in the patients. The rate of this decrease was significantly higher in patients with severe (p = 0.062) and fatal (p = 0.078) disease. Moreover, most patients had elevated levels of LDH (96.9%), CRP (82.8%), and urea/creatinine ratio (83.1%).

Table 2 and figure 1 tabulate the two groups' important differences in laboratory findings. This data also highlighted different degrees of alternations in the liver (higher levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST)), kidney (higher levels of blood urea nitrogen, serum creatinine, and their ratio), and heart (higher levels of creatine phosphokinase (CPK) and LDH) function tests.

89.1% of 427 patients had abnormal CT scans with varying levels of lung involvement. The most common patterns on the chest CT scans were the simultaneous presence of two crazy paving and signs of consolidation (27.1%), followed by the ground-glass opacity (24.7%) (Table 2; Figure 2). Normal chest CT scans were more common in the non-severe group of patients. In addition, crazy paving and distortion had a significant relationship with the fatal outcome. Among the patients, 25.8% had lungs involvements more extensive than 50%.

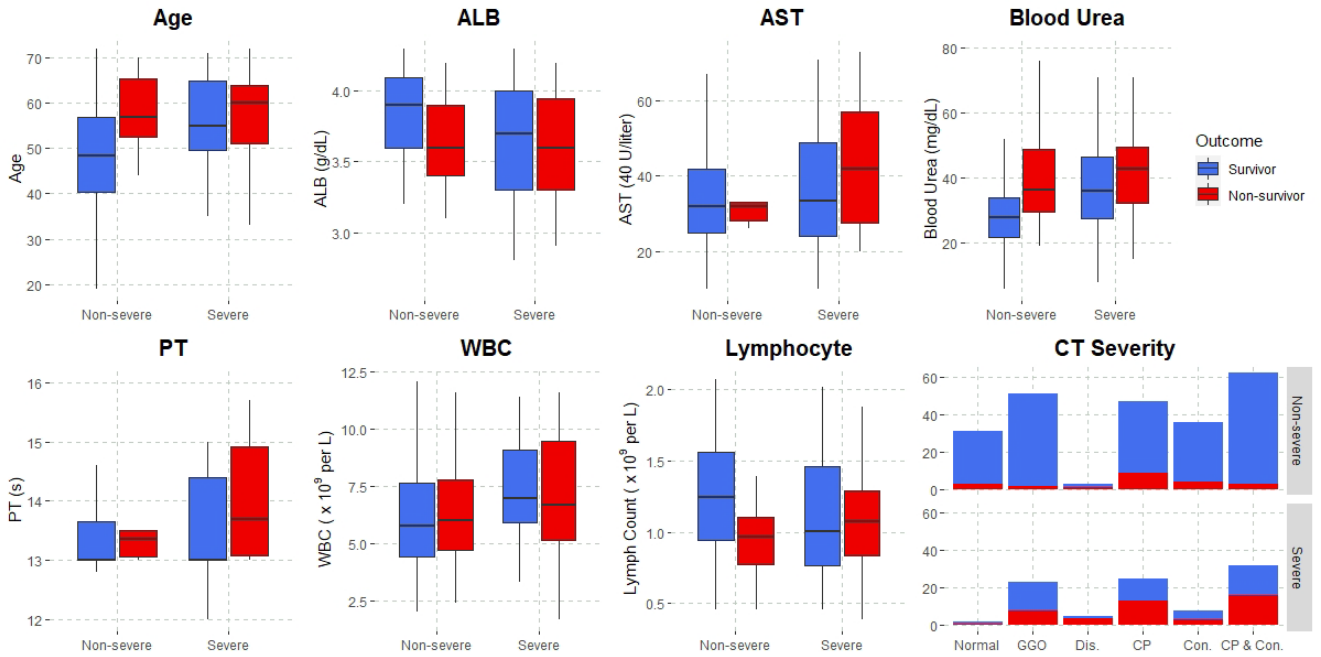

Figure 1. The box plot and stacked-bar chart were used to summarize the distribution of numerical important statistical data through displaying their quartiles and their medians in both severity of the disease and the secondary outcomes groups. The text above each box plot indicates each name of the important statistical data. The black line inside the box shows the median. ALB: albumin, AST: aspartate aminotransferase, PT: prothrombin time, WBC: White blood cells

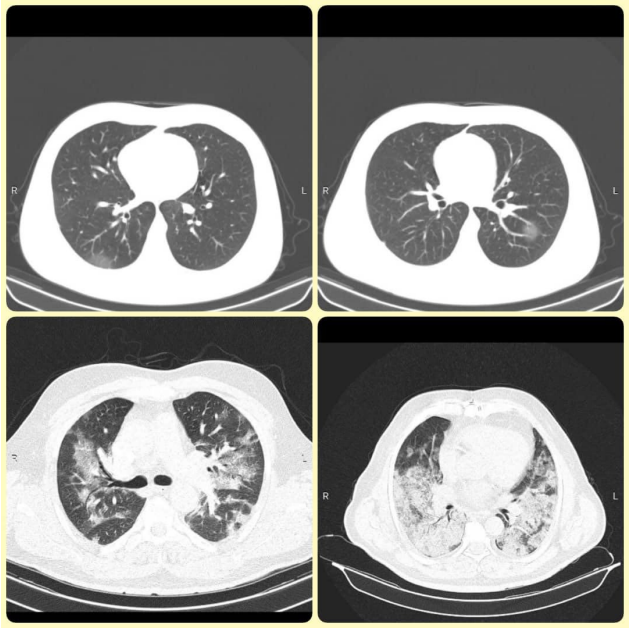

Figure 2. Chest computed tomography (CT) scans of different patterns of COVID-19 lungs involvement; (a, b) chest CT scan from two 35 and 42 years old patients showed scattered peripheral patches of ground-glass opacities; (c) chest CT scan from a 62 years old patient showed crazy paving; and (d) chest CT scan from a 78 years old patient showed diffuse bilateral lungs involvement with consolidations and tissue distortion, signifying gradually aggravated underlying pathogenic process

Outcomes

As discussed, 124 (29%) cases were in critical condition on admission, and 81 (19%) patients were admitted to the ICU. Until the end of the study, 259 patients with COVID-19 fully recovered and survived; unfortunately, 68 (16%) patients died. The other 100 patients were hospitalized then and were not analyzed for secondary outcome results. Variables accountable for death are demonstrated in Table 1 and 2.

DISCUSSION

Among the countries with the highest prevalence of the COVID-19 pandemic, many reported the clinical conditions of the patients, but there exists limited data from many countries, including Iran and other Middle Eastern nations. This study was designed and conducted to address this shortcoming by publishing the clinical conditions of the patients with COVID-19 cases in the first peak of the disease in the North East of Iran in the Middle East. In line with reports from other countries (China and

the USA), and as the study's first and most important finding, the median age of patients with severe was significantly higher than those with non-severe diseases (14,15). Most published studies have reported that the elderly, men, and patients with diabetes are more likely to have a fatal outcome (14, 16, 17).

Based on the present results, although women may develop a more severe form of the disease, men's mortality rate is higher. Therefore, these factors could be considered predictors of the outcome, especially in centers with limited human and equipment resources. Moreover, the results of this study indicate that more attention should be paid to these high-risk patients on admission, and the mentioned factor should be considered as an ICU-allocation criterion. The immune system is weak in high-risk patients, and the virus can inflict more damage; therefore, timely administration of antiviral, antibacterial, and immune booster drugs should be considered to prevent secondary infections and reduce the mortality rate.

As SARS-CoV-2 is a respiratory virus, most patients' symptoms on admission are respiratory and infection-related; however, non-specific clinical presentations can complicate the diagnosis (9). Cough, fever, and dyspnea were the most common symptoms in the reports from Wuhan, New York, and the present study (15,16,18). However, there were some cases without fever or cough; therefore, assessment of the patients merely for these common symptoms can lead to underdiagnosis.

Similar to other studies, leukopenia, lymphopenia, and neutrophilia, as well as alterations in the prothrombin time and elevated inflammatory markers (including LDH and CRP), were the most common laboratory findings in our patients, which were significantly more common in the severe cases and non-survivors (14, 17, 19-21). It has been proposed that following the infection with the virus; there can be an impairment in the immune responses in terms of both T-helper and T-regulatory cells, which is manifested as abnormal leukocyte and lymphocytes counts (21). These laboratory manifestations are similar to those previously observed in patients with MERS-CoV and SARS-CoV infections (19).

On the admission, in the severe and fatal cases, levels of AST, blood urea, and serum creatinine levels reflect significantly higher liver and kidney damage. As suggested in other studies, these laboratory findings indicate an association between cellular immune deficiency due to COVID-19 infection and liver and kidney damages. Cheng et al. findings showed an association between kidney damage and poor outcome in patients with COVID-19. They reported that elevated baseline serum creatinine had a statistically significant association with ICU admission and death. In this regard, they hypothesized that as angiotensin-converting enzyme 2 (ACE2) is the main cell receptor for virus entry and is expressed in the kidney 100 times higher than lungs, the virus can damage kidneys more severely (22). The damage to the critical organs can be due to the cytokine storm (induced by the virus invasion) and neutrophilia. Besides, the low median of SpO_2 at admission, which has been reported to be significantly lower in the non-survivors, might be the most influential element of the cascade that resulted in tissue hypoxia, acute kidney injury, and shock, in addition to the direct damages of the virus (14, 19). Due to the rapid damage of the virus to vital organs, early identification and timely management of patients in critical conditions are imperative.

The association between the crazy-paving pattern and the severe outcomes was an interesting CT scan finding in the present study. Along with GGO, crazy paving was also common in patients with low SpO_2.

The first limitation of the present study was the incomplete laboratory records in some cases, which could affect the results of the statistical analyses. We examined each laboratory finding independently in the group of patients with those data to decrease the impact of the missing data. Secondly, as some cases were still hospitalized at the time of analysis, their information was not included in secondary outcome analysis. Third, the disease's incubation period could not be determined in the patients as some were referred to the hospital several days after the onset of the symptoms.

In conclusion, the present data emphasized that elderly patients with underlying comorbidities are vulnerable to

severe outcomes after contracting COVID-19. According to the results of the present study, SpO_2 percentage and inflammation markers on admission and during hospitalizations predict a poor outcome. It is proposed that clinicians consider these factors for prioritizing and admission of patients to hospitals and ICU wards.

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