

Review Article

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**Clinical characteristics, laboratory profile
and imaging results in COVID-19 cases****Mohammad Nematshahi¹; Mahboubeh Neamatshahi²; Fahimeh Attarian^{3*}; Davood Soroosh^{4*}; Faeze Rahimi⁵**¹Department of Anesthesiology, School of Medicine, Sabzevar University of Medical Science, Sabzevar, Iran.²Community Medicine Department, Sabzevar University of Medical Sciences, Sabzevar, Iran.³Department of Public Health, School of Health, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran.⁴Clinical Research Development Unit, Hospital Research Development Committee, Sabzevar University of Medical Sciences, Sabzevar, Iran.⁵Clinical Research Development Unit, Hospital Research Development Committee, Sabzevar University of Medical Sciences, Sabzevar, Iran.***Corresponding Author: Fahimeh Attarian**

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Abstract

Background: COVID-19 has been identified as one of the most urgent issues in health care systems worldwide. Identification of the prognostic-related characteristics in the patients with COVID-19 for timely diagnosis and treatment is the most important current priority of treatment systems. This study aimed to determine the clinical characteristics, laboratory and imaging profile of COVID-19 cases.

Methods: This cross-sectional study carried out on 508 suspected or confirmed patients with COVID-19 who were hospitalized and treated between February 2020 and May 2020. The data were included age, gender, clinical and laboratory findings, and outcome in the patients. After describing the data, any possible relationship between the patients' characteristics and outcome was assessed in the sample.

Results: The mean age of the patients was 59.3 ± 18.2 years and 55.9% were male. Polymerase Chain Reaction (PCR) test was positive in only 33.3% of the hospitalized patients. Shortness of breath, fever and dry cough were the most common symptoms and 16.3% of the patients required Intensive Care Unit (ICU). Finally, 81.9% of the patients improved and 18.1% were died. Changes in the heart rhythm, blood pressure and O₂ saturation level, WBC and percentage of abnormal lymphocytes, creatinine and potassium levels were the most important factors associated with mortality in the patients ($P < 0.05$).

Conclusion: COVID-19 is a new infectious disease in which fever and cough are the most common clinical symptoms, even if they do not have a confirmed diagnosis. In this study, in addition to old age, some clinical symptoms and hematological markers were observed in the patients that may be helpful in the prognosis of the patients with COVID-19.

Keywords: COVID-19; hematological marker; clinical symptoms.

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Introduction

COVID-19 was first reported in Wuhan, China in December 2019, and is one of the most important current health problems worldwide [1]. The World Health Organization (WHO) introduced it as the current health emergency [2]. In Iran, the first case of COVID-19 was reported in late February 2020 in Qom and then spread rapidly throughout Iran [3]. Since humans are now recognized as the most important source of infection and the most common method of transmitting the disease through contact with the respiratory droplets of an infected person [1,4], the most important way to control the spread of the disease is breaking the transmission chain with rapid detection [5,6]. On the other hand, in order to reduce the complications and fatality of the disease, recognizing the clinical and laboratory characteristics of hospitalized patients and timely diagnosis and treatment and identifying factors related to patients' prognosis is the current priority of treatment systems that will reduce complications and mortality [7-9]. Currently, Polymerase Chain Reaction (PCR) or detection of the virus genome in the serum of an infected person is the gold standard for diagnosis [6,9]. PCR is time consuming and difficult [9] and may be erroneous but is the only criterion for definitive diagnosis [7,8]. However, there is ample evidence that diagnosis through lung imaging is faster, cheaper, and more valuable than PCR [7,10]. Although there is still no complete evidence for factors associated with increased mortality in the patients but the patient's age, gender and associated underlying disease such as hypertension and diabetes and a previous history of pneumonia or malignancy, fever, cough, respiratory involvement, decreased white blood cells and increased neutrophils are the most important possible factors associated with poor prognosis in the hospitalized patients due to COVID-19 [6,11-14].

However, as different evidences of the prevalence and severity of the COVID-19 have been reported in different races or geographical areas, the need for further epidemic studies in different parts of the world is felt [1,2,12]. A study by Khalili et al, which was performed on 1061 patients admitted to Masih Daneshvari hospital in Tehran, showed that gender, age, white blood cell count and neutrophil and lymphocyte percentage in patients with COVID-19 were decreased. The most important hematological markers such as creatinine, potassium, total blood proteins, troponin and albumin are the most important biochemical factors with poor prognosis in these patients [15]. In a study by Moghaddami et al, the clinical, laboratory and demographic characteristics of 113 confirmed patients with COVID-19 was assessed and the reduction of O₂ saturation was the most important finding related to poor prognosis in these patients [14]. The present study was performed to determine and describe clinical, laboratory and radiological findings in the suspected and confirmed COVID-19 in Sabzevar.

Methods

This cross-sectional study carried out on 508 suspected or confirmed patients with COVID-19 who were hospitalized and treated between February 2020 and May 2020 in Sabzevar hospital as a medical center dedicated to the treatment of COVID-19. It is noteworthy that since the beginning of the COVID-19 pandemic in Iran, one medical center in each city has

been dedicated to treat this disease. In this study, the method of sampling was census and all suspected COVID-19 referred to the hospital at a certain time were included in the study.

All hospitalized patients, after initial tests and basic examinations were evaluated for infection with COVID-19 using PCR test and imaging. According to the definition of the World Health Organization, the confirmed case of COVID-19 was considered as a patient with a positive test of the Real-Time Reverse-Transcription-Polymerase-Chain-Reaction (RT-PCR) in the respiratory secretions for the presence of SARS-CoV-2 virus. A suspected case was also considered as a patient with a negative test or without a test but with clinical symptoms of pneumonia, fever, cough or respiratory involvement [16]. The variables evaluated in this study include age, gender, underlying disease or other clinical variables such as systolic and diastolic blood pressure (mmHg), respiration rate (rate / minute) and heart rate (beats / minute), fever, dry cough, shortness of breath, sore throat and blood panel including Complete Blood cell Count (CBC), C-Reactive Protein (CRP), erythrocyte sedimentation rate [2], blood P^H, chest imaging and PCR results. After describing the variables, any possible association between clinical and laboratory findings and outcome in these patients was assessed.

Statistical issues

After collecting the data, quantitative variables were described as mean and standard deviation, and qualitative variables were also described as frequency and percentage. Then, any statistical relationship between variables and disease outcome was examined by Chi-square test, Fisher's exact test or independent t-test. A P value less than of 0.05 was considered significant.

Results

In this study, 508 suspected and confirmed patients with COVID-19 with a mean age of 59.3 ± 18.22 years (ranging from 12 to 94 years) were admitted to Sabzevar hospital during the first peak of COVID-19 in Iran. There were 284 men (55.9%) and 224 women (44.1%). PCR test was positive in only 169 patients (33.3% of patients), while chest imaging results were abnormal in 408 patients (80.3% of patients). Also, 16.3% of patients (83

Table 1: General status of suspected or confirmed patients COVID-19.

	Variable	Frequency (%)
Gender	Male	284 (55.9)
	Female	24 (44.1)
PCR	Positive	69 (33.3)
	Negative	83 (55.7)
	Not reported	56 (11)
Chest imaging	Normal	00 (19.7)
	Abnormal	08 (80.30)
Need to ICU	No	425 (83.70)
	Yes	3 (16.30)
Outcome	Recovery	16 (81.90)
	Death	2 (18.10)

Table 2: Frequency of clinical symptoms and chest imaging results in the suspected or confirmed patients with COVID-19.

Variable		Frequency (%)	Variable		Frequency (%)
Abdominal pain	No	494 (97.2)	Comorbidity	No	245 (48.2)
	Yes	14 (2.8)		Yes	263 (51.8)
Nausea	No	472 (92.9)	Fever	No	214 (42.1)
	Yes	36 (7.1)		Yes	294 (57.9)
Vomiting	No	463 (91.1)	Shortness of breath	No	116 (22.8)
	Yes	45 (8.9)		Yes	392 (77.7)
Consolidation	No	306 (75.2)	Dry cough	No	217 (42.7)
	Yes	102 (25.0)		Yes	291 (57.3)
Ground glass opacity	No	70 (12.7)	Sore throat	No	479 (94.3)
	Yes	338 (82.8)		Yes	29 (5.7)
Bilateral lung involvement	No	115 (28.3)	Headache	No	501 (98.6)
	Yes	285 (70.2)		Yes	7 (1.4)

patients) equired to be admitted to the Intensive Care Unit (ICU) and finally 416 patients (81.9%) recovered and were discharged. Death was occurred in 92 patients of suspected or confirmed patients (Table 1).

The length of stay at hospital varied from 1 to 44 days with a mean of 5.53 days. The mean oxygen saturation was $88.1 \pm 9.7\%$ and the patients' heart rate and respiratory rate were 93.67 and 20.49 times per minute, respectively, and the mean systolic and diastolic blood pressures were 110.8 and 7.3 mmHg, respectively. Fever (57.9%), dry cough (57.3%) and shortness of breath (77.7%) were the most common clinical symptoms. Ground glass opacity (82.8%), consolidation (25%) and bilateral lung involvement (70.2%) was the most important radiological findings in the suspected or confirmed patients with COVID-19 (Table 2).

Hematological evaluation of the patients showed that the mean number of white blood cells in the sample was 7,932 cm and the mean hemoglobin was 12.7 g/dl. The percentage of lymphocytes and neutrophils were 20% and 76%, respectively and the mean erythrocyte sedimentation rate was 34.95 mm/h. Other biochemical profile and blood panel evaluation are summarized in Table 3.

Age, fever, dry cough, lethargy, irregular heart rhythm, systolic and diastolic blood pressure, White Blood Cell (WBC) and hemoglobin levels, lymphocyte and neutrophil count, creatinine level, blood potassium, O₂ saturation and hospitalization in the Intensive Care Unit (ICU) were the most important clinical and laboratory findings related to outcome in these patients.

Table 3: Evaluation of cellular and biochemical profiles of in suspected or confirmed patients with COVID-19.

Variable	Mean \pm SD	
WBC	WBC (cmm)	9329 \pm 7276
	Lymphocytes (%)	0 \pm 12
	Neutrophils (%)	6 \pm 13
	Hemoglobin (g/dl)	2.69 \pm 2.27
Ilochemical profile	Cr (mg/dl)	.4 \pm 1.7
	Na (meq/l)	37.5 \pm 9.65
	K (mmol/l)	.14 \pm 0.6
	PH	.3 \pm 0.36
ESR (mm/h)	4.95 \pm 30.3	

Consolidation was also the most important outcome-related radiological finding in these patients. Any association between clinical, laboratory, and radiological characteristics and outcome in these patients is summarized in Tables 4 and 5.

Discussion

In the present study, clinical symptoms, laboratory markers and chest imaging results were evaluated in a sample of suspected or confirmed patients with COVID-19 admitted to Sabzevar hospital. Only 33.3% of the patients admitted to the COVID-19 specific hospital had a positive PCR test and there was no significant difference between the survivors of the COVID-19 and the deceased patients and 16.30% of all patients were admitted to the ICU. Hospitalization in the ICU was associated with mortality. Mortality of the patients in the first peak of COVID-19 in Sabzevar was 18.1% and the most common clinical symptoms were fever, dry cough and lethargy and the most important hematological and biochemical markers associated with poor prognosis was an increase in the mean White Blood Cell (WBC) and decrease in the percentage of lymphocytes and the level of creatinine and potassium. Consolidation was also the most important finding of abnormal chest imaging associated with mortality.

In the present study, the mean age of the patients was approximately 60 years. Older age and the underlying disease was the most common characteristic of suspected or confirmed patients with COVID-19 [12,14,17-20]. Similarly, in a study by Khalili et al, which was performed on 1,061 suspected or confirmed patients with COVID-19 in Tehran, a significant difference in the mean age of the patients was reported according to the outcome of the disease [15]. In a study by Wang et al, the mean age was higher and the prevalence of the underlying disease was reported in the patients with more severe disease or hospitalization in the ICU than other patients [17]. Shahriarirad et al in a study on the patients with confirmed COVID-19 reported the highest mortality rate in the patients over 75 years of age accompanied by underlying disease [14].

The sex ratio (male to female) in the present study was 1.27, which was similar to the results of previous studies in Iran and other parts of the world. The need for hospitalization was 1.22 [21] and in the secondary study of 6,515 suspected or confirmed patients was 1.30 [22]. In another study, sex ratio was 1.98 [19] and in different results in a sample of 1,420

Table 4: Comparison of clinical symptoms in the patients who recover or died following COVID-19.

Variable		Outcome		P value
		Death	Recovery	
Gender	Male	57 (62.0)	227 (54.6)	0.19*
	Female	35 (38.0)	189 (45.4)	
Fever	No	53 (57.6)	161 (38.7)	0.001*
	Yes	39 (42.4)	255 (61.3)	
Dry cough	No	63 (68.5)	154 (37.0)	<0.001*
	Yes	29 (31.5)	262 (63.0)	
Sore throat	No	88 (95.7)	391 (94.0)	0.53*
	Yes	4 (4.3)	25 (6.0)	
Headache	No	92 (100)	409 (98.3)	0.36**
	Yes	0	7 (1.7)	
Abdominal pain	No	90 (97.8)	404 (97.1)	0.99**
	Yes	2 (2.2)	12 (2.9)	
Nausea	No	82 (89.1)	390 (93.8)	0.11*
	Yes	10 (10.9)	26 (6.2)	
Vomiting	No	80 (87.0)	383 (92.1)	0.11*
	Yes	12 (13.0)	33 (7.9)	
PCR	Negative	57 (61.9)	226 (54.3)	* 0.39
	Positive	27 (29.3)	143 (34.1)	
	Not reported	8 (8.7)	48 (11.5)	
Shortness of breath	No	17 (18.5)	99 (23.8)	0.27*
	Yes	75 (81.5)	317 (76.2)	
Lethargy	No	56 (60.9)	382 (91.8)	<0.001*
	Yes	36 (39.1)	34 (8.2)	
Heart rate	Tachycardia	43 (47.8)	145 (35.5)	0.03*
	Normal	43 (47.8)	255 (62.3)	
	Bradycardia	4 (4.4)	9 (2.2)	
Breath rate	Normal	87 (96.6)	397 (97.0)	0.74**
	Abnormal	3 (3.3)	12 (2.9)	
Neutrophils	Normal (>1500)	75 (87.2)	361 (90.9)	0.29*
	Abnormal (<1500)	11 (12.8)	36 (9.1)	
Lymphocytes	Decreased (<1100)	60 (69.0)	156 (39.3)	<0.001*
	Normal (1100-3000)	23 (26.4)	220 (55.4)	
	Increased (>3000)	4 (4.6)	21 (5.3)	
ICU admission	No	59 (64.1)	366 (88.0)	<0.001*
	Yes	33 (35.9)	50 (12.0)	
CT	Normal	13 (14.1)	87 (20.9)	0.14*
	Abnormal	79 (85.9)	329 (79.1)	
Consolidation	No	43 (54.4)	263 (79.9)	<0.001*
	Yes	36 (45.6)	66 (20.1)	
Ground glass opacity	No	18 (22.8)	52 (15.8)	0.14*
	Yes	61 (77.2)	277 (84.2)	
Bilateral lung involvement	No	15 (19.2)	100 (30.5)	0.09**
	Yes	62 (79.5)	223 (68.0)	
	Not reported	1 (1.3)	5 (1.5)	

Table 5: Comparison of quantitative variables in the patients who recover or died following COVID-19.

Variable	Outcome	N	Mean ± SD	P value
Age	Recovery	416	57.3 ± 18.8	0.04
	Death	92	68.5 ± 15.8	
Systolic blood pressure	Recovery	409	119.5 ± 20.6	<0.001
	Death	90	113.3 ± 30.2	
Diastolic blood pressure	Recovery	410	73.9 ± 11.8	0.03
	Death	87	70.0 ± 13.6	
O ₂ saturation	Recovery	406	89.2 ± 8.6	<0.001
	Death	89	82.2 ± 12.1	
Heart rate	Recovery	409	93.1 ± 16.3	0.003
	Death	90	95.8 ± 21.6	
WBC	Recovery	401	76217 ± 6688	0.04
	Death	88	93509 ± 9425	
Lymphocytes	Recovery	397	0.22 ± 0.1	<0.001
	Death	87	0.14 ± 0.1	
Neutrophils	Recovery	397	0.74 ± 0.1	0.04
	Death	86	0.82 ± 0.1	
Hemoglobin	Recovery	401	12.8 ± 2.1	<0.001
	Death	88	12.1 ± 2.8	
Creatinine	Recovery	371	1.21 ± 0.7	0.001
	Death	88	2.20 ± 1.7	
Potassium	Recovery	361	4.11 ± 0.5	<0.001
	Death	87	4.26 ± 0.8	

confirmed European patients with mild to moderate disease, this ratio was 0.47 [12]. Although in the present study, no statistically significant relationship was found between gender and mortality ($p = 0.19$), but the possibility of a relationship between gender and disease severity and different prognosis in the two genders according to the findings of the present study and previous studies should be considered [23]. In the present study, the most common clinical symptoms in the patients with COVID-19 was fever (57.9%), dry cough (57.3%) and shortness of breath (77.7%), which were mainly related to the mortality of the disease. This finding was consistent with the results of previous findings [24-27]. In a secondary study by Cao et al, the most common symptoms were fever (87.3%) and cough (58.1%) [21]. A study conducted in southern Iran also identified fever (67.59%) and cough (73.64%) as the most common symptoms in confirmed hospitalized patients [14].

Previous findings show arrhythmia and tachypnea, changes in blood pressure, and oxygen saturation are the most important clinical features associated with mortality in the patients with COVID-19 [14,17,21,28,29]. In the present study, these factors also were related to mortality. The highest mean heart rate and the lowest level of oxygen saturation and blood pressure were seen in the patients with more severe disease. Increasing the mean of white blood cells and decreasing the percentage of lymphocytes and decreasing the amount of hemoglobin in the blood were also the most important hematological findings related to the mortality. These findings were consistent with lots of studies [14,15,18,21,26]. Cao et al also reported a decrease in blood lymphocytes (lymphopenia) in 57% of the patients and an increase in white blood cells in 11% of cases [21]. In a study by Pourabdollah et al., the highest mean number of white blood cells and blood creatinine level and the lowest level of lymphocytes

were reported in deceased patients [15]. However, in studies with low sample size, this relationship was not significant [14].

Another important finding of the present study was the results of abnormal imaging results in the patients studied, so that evidence of consolidation was seen on imaging of a quarter of patients. Ground glass opacity and bilateral lung involvement were the most common abnormal findings of lung CT in the patients. On the other hand, there was a significant relationship between abnormal imaging results and mortality of the patients, so that consolidation and bilateral lung involvement were related to mortality. This finding was consistent with the findings of previous studies; however a lot of evidence reports the diagnostic value of imaging findings in COVID-19 patients [7,9,10,21,30,31]. In a study by Ng et al and Besharat et al. ground glass opacity and consolidation lesions were reported as the most common abnormal findings in CT [7,32]. In the secondary study by Cao et al. the results of 31 studies showed that ground glass opacity and bilateral lung involvement were as the most common radiological findings [21].

Overall, the fatality rate of the disease in the present study was 18.1%, and Rodriguez-Morales et al reported the mortality rate in hospitalized patients at 13.9% [27]. The need for ICU hospitalization in our study was observed in one-sixth of patients, which was lower than the estimates of previous studies [21]. The mortality rate in ICU patients was also 36%, which was much lower than previous estimates. The mortality rate in ICU patients was estimated to be 41.9% [33]. In a study performed on 1,061 patients admitted to Tehran hospital, the fatality rate in hospitalized patients was reported to be 12.2% [15]. Although in the study of Cao et al., the fatality rate of the disease in all patients in China was estimated to be 6%, [21]. The low estimate of mortality rate in this study is probably due

to the study of the results of 31 articles in which the data of all patients with confirmed COVID-19 were studied regardless of hospitalization status. In another secondary study, on the data of 3,600 suspected or confirmed patients, 25.6% of the cases were severe and the fatality rate of the disease was 3.5% [26]. Despite the appropriate sample size and complete review of patients' files, this study has some limitations. The first limitation of the present study is the admission of hospitalized patients with COVID-19 and the lack of outpatient's cases. Incomplete completion of the case has been another limitation of the present study, which can be expected according to its retrospective approach.

Conclusion

COVID-19 is a new infectious disease in which fever and cough are the most common clinical symptoms, even if they do not have a confirmed diagnosis. In this study, in addition to old age, some clinical symptoms and hematological markers were observed in the patients that may be helpful in the prognosis of the patients with COVID-19.

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