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ORIGINAL ARTICLE

Effects of Clinical Symptoms and Laboratory Values of COVID- 19 Patients' Tests at the Time of Hospitalization on Their Clinical Outcomes

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ABSTRACT

Introduction: At the end of 2019, a new coronavirus caused pneumonia in Wuhan, China. Several studies have described the clinical features and immune manifestations in COVID-19 patients with moderate to severe symptoms, while their clinical relevance is less clear. This study investigates the effects of clinical symptoms and laboratory values of COVID-19 patients' tests at the time of hospitalization on their clinical outcomes.

Methodology: This descriptive cross-sectional study was performed on COVID-19 patients hospitalized in Arak hospitals from April 2020 to March 2020. Medical records of all the hospitalized patients were retrieved. Trained personnel extracted general information (age and gender) and clinical profiles (the complete blood count and other required tests).

Findings: Analyzing the laboratory indices of the blood count and LDH and CPK levels revealed a positive relationship between the patients' serum CPK levels, and the mortality rate (P = 0.001) and length of hospitalization (P = 0.015).

Conclusion: The patients' serum LDH levels and fever were also associated with the mortality rate, and the need for mechanical ventilation, respectively. We hope this information helps physicians treat COVID-19 patients.

Keywords: COVID-19, clinical symptoms, laboratory tests

INTRODUCTION

At the end of 2019, the new coronavirus caused pneumonia in Wuhan, China. Its rapid spread caused an epidemic, first in China and then around the world (1). After announcing the first cases of the new coronavirus, its infection rate and caused mortality had an upward trend until February 20 (2). This disease is caused by an RNA virus from the coronaviridae family transmitted by respiratory particles or contaminated surfaces (3). The disease has no specific symptoms, with asymptomatic individuals at one, and those with fatal pneumonia at the other end of the spectrum (4). Most people get the mild form of the virus, and their symptoms often appear in the form of fever (82%) and cough (81%). Severe pneumonia and acute respiratory failure are observed in 14% of patients with 2-4% mortality rate (5). Given the rapid prevalence and high mortality of coronavirus infection, efficient diagnostic methods should be invented for timely diagnosis, prompting treatment and reducing infection (6). The first COVID-1P patient in Iran was reported on February 19, 2020 in the city of Qom (7). This virus spread rapidly throughout Iran and made it one of the centers of disease in the world (8). So far, a total of 257,303 laboratory cases and more than 12,000 deaths have been recorded in Iran (9).

Coronavirus infection causes a crisis-like condition for people with underlying diseases such as heart disease, diabetes, high blood pressure, and previous respiratory illnesses, leading to increased hospitalization lengthas well as mortality rate (10 ، 11).Most patients experience symptoms such as dry cough, sore throat, and fever (12-15), while others have severe complications such as pulmonary edema, sepsis, organ failure, and even acute respiratory distress syndrome (16-18).

Despite recognizing clinical signs of coronavirus and its relationship with the prognosis of the disease, the relationship between changes in laboratory parameters and prognosis of COVID-19 patients is still unclear.However, it is reported that this disease increases the level of white blood cells (WBC), lactate dehydrogenase (LDH), creatine kinase (CK), protein (D –CRPdimer) and decreases the number of lymphocytes, especially 8CD + cells; also, inflammatory cytokines are associated with more severe symptoms, more pulmonary involvement, and higher rates of hospitalization the ICU, and mortality (19).

Several studies have described the clinical features and immune manifestations in COVID-19 patients with moderate to severe symptoms, while their clinical relevance is less clear. This study investigates the effects of clinical symptoms and laboratory values of COVID-19 patients at the time of hospitalization on their clinical outcomes.

METHODOLOGY

Study Design: This descriptive cross-sectional study was performed on COVID-19 patients hospitalized in Arak hospitals from April 2020 to March 2020.

Study Site: Arak training-medical hospitals used for hospitalizing COVID-19 patients during the epidemic.

Study Population: This study was performed on adults (male / female, regardless of ages) diagnosed with COVID-19 infection through reverse transcriptase-polymerase chain reaction (RT-PCR).

Data Source: Medical records of all the hospitalized patients were retrieved. Trained personnel extracted general information (age and gender) and clinical profiles (the complete blood count and other required tests).

Variables: After signing the informed consent forms, volunteers who met the inclusion criteria were admitted to the study. The inclusion criteria werethe confirmed COVID-

19 symptoms and the need for hospitalization according to national guidelines (R.R.> 33 or saturation <93) or physician's opinion.Exclusion criteria were also negative results of the PCR test, causes of pneumonia other than COVID-19, and incomplete patient records. Data extracted from the patients' records included the complete blood count and other required biochemical tests such as CPK, LDH, and inflammatory markers.In addition, patients' clinical signs at the time of hospitalization, such as fever, dry cough, body aches, shortness of breath, headache, decreased olfactory and gustatory senses, ICU admission history, hospitalization length, and artificial respiration were registered.

Data Analysis: The collected data were analyzed by SPSS 23 software. Descriptive statistics are expressed using central indices and dispersion indices, and qualitative data are shown by frequency and percentage.

Table 1

	Mortality		yes	no	Pvalue
		<4000	3	33	
		4000-10000	11	192	0.494
WBC		10000-16000	2	57	
		>16000	0	22	
		<12	1	44	
		12-14	9	146	0.546
Hb		14-16	6	95	
		>16	0	19	
Plt		<150000	2	70	0.326
		>150000	14	234	
LDH		Elevated	13	102	0.000
		Normal	3	202	
CPK		Elevated	9	247	0.015
		Normal	7	57	
	Hospital day		N	Mean ±std. deviation	Pvalue
		<4000	35	10.91±4.84	
		4000-10000	192	11.06±5.00	0.631
WBC		10000-16000	58	10.86±5.49	
		>16000	21	12.47±5.20	
		<12	45	10.60±5.54	
		12-14	147	11.19±5.01	0.630
Hb		14-16	97	11.41±4.96	
		>16	17	9.94±5.00	
Plt		<150000	69	10.59±5.07	0.343
		>150000	237	11.52±5.05	
LDH		Elevated	107	10.57±4.73	0.101
		Normal	199	11.38±5.22	
CPK		Elevated	63	11.00±5.08	0.497
		normal	243	11.49±5.03	
	ICU addmite		yes	no	
		<4000	1	35	
		4000-10000	12	191	
WBC		10000-16000	3	56	0.596
		>16000	0	22	
		<12	3	42	
Hb		12-14 14-16	6 7	149 94	0.480
		>16	0	19	
Plt		<150000	2	70	0.326
		>150000	17	234	
LDH		Elevated	9	106	0.082
		Normal	7	198	

CPK		Elevated	9	247	0.015
		Normal	7	57	
	Ventilation		yes	no	Pvalue
		<4000	1	35	
		4000-10000	9	194	
WBC		10000-16000	0	59	0.418
		>16000	1	21	
		<12	2	43	
Hb		12-14 14-16	2 7	153 94	0.083
		>16	0	19	
Plt		<150000	2	70	0.727
		>150000	9	239	
LDH		Elevated	4	111	0.976
		Normal	7	198	
CPK		Elevated	4	60	0.167
		Normal	7	249	

RESULTS

Clinical profile: From April 1, 2020 to March 2020, 320 reported COVID-19 patients were included in the analysis. The relationship between laboratory values and disease outcomesofthese patients is presented in Table 1.

Blood count, LDH, and CPK levels showed that the serum CPK level of patients was related to the mortality rate (P = 0.001) and length of hospitalization (P = 0.015). Patients' serum LDH levels were also associated with the mortality rate (P = 0.015). But none of the CBC indicators were related to mortality, ICU admission, length of hospitalization, and artificial respiration (Table 1).

Prognosis and Outcome: Tables 2-8 show the prevalence of clinical symptoms and their relationship with the mortality rate, ICU admission, length of hospitalization, and artificial respiration.

	Fever		yes	no	Pvalue
mortality		yes	7	9	
		no	153	150	0.599
ICU		yes	10	6	
		no	150	153	0.311
Ventilation		yes	9	2	0.033
		no	151	157	
	Dry cough		yes	no	Pvalue
mortality		yes	9	7	
		no	176	118	0.358
ICU		yes	1	44	
		no	9	146	0.693
Ventilation		yes	7	4	0.852
		no	188	121	
	Dyspnea		yes	no	Pvalue
mortality		yes	6	10	
		no	114	190	0.611
ICU		yes	6	10	
		no	114	190	0.597
Ventilation		yes	6	5	0.235
		no	114	195	
	Body pain		yes	no	Pvalue
mortality		yes	13	3	
		no	179	125	0.075
ICU		yes	10	6	
		no	182	122	0.527

Table 8.2

Ventilation	yes		7	4	0.802
	no		155	124	
Anosemia			yes	no	Pvalue
mortality	yes		3	13	
	no		54	250	0.920
ICU	yes		1	44	
	no		9	146	0.546
Ventilation	yes		1	10	0.442
	no		56	253	
Taste			yes	no	Pvalue
mortality	yes		3	13	
	no		57	247	0.649
ICU	yes		5	11	
	no		55	249	0.920
Ventilation	yes		2	9	0.189
	no		58	251	
Headache			yes	no	Pvalue
mortality	yes		3	13	
	no		63	242	0.494
ICU	yes		3	13	
	no		63	242	0.585
Ventilation	yes		3	13	0.873
	no		63	242	

Analyzing the patients 'clinical symptoms manifested that dry cough (60.9%), body ache (60%) and fever (50.1%) were the most common symptoms. Among the clinical symptoms, only fever was related to patients' need for mechanical ventilation (P = 0.033).However, dry cough, body aches, shortness of breath, headache, and decreased olfactory and gustatory senses were not associated with the mortality rate, ICU admission, hospitalization length, and artificial respiration.

This descriptive cross-sectional study reviewed the medical records of 320 adult patients to assess the clinical profiles and laboratory results of COVID-19 patients. Perusing the laboratory indicators of blood count, as well as LDH and CPK levels revealed a positive relationship between the serum CPK level andmortality rate (P = 0.001) and length of hospitalization (P = 0.015).Increased white blood cell cells often indicate inflammatory responses to bacterial infection or disease progression.

Patients with severe viral infections are more likely to co-infect with bacteria due to decreased immune functions. Among other coronavirus infection, cytokine storms and immune pathology could be mentioned. Excessive inflammation occurs in the absence the immune response regulation.

The inflammatory response can stimulate the production of inflammatory cells and accelerate the apoptosis of lymphocytes (20). COVID-19 Patients with lymphopenia experience a significantly lower risk of death (21).The neutrophil to lymphocyte ratio is an independent risk factor for the death of COVID-19 patients at hospitals (22).Therefore, the inflammatory parameters in the early stages of the disease should be carefully attended. The number of white blood cellscould be quickly revealedby a routine inpatient blood test, which greatly helpsto identify high-risk COVID-19 patients in the early stages.

In this study, the patients' serum LDH levels were also associated with the mortality rate (P = 0.015), while no relationship was found amongthe CBC indicators and mortality, ICU admission, length of hospitalization, and artificial respiration.High levels of D-dimers, NLR, CRP, ferritin as well as lymphopenia and low levels of eosinophils, commonly found in COVID-19 patients, wereaccountable markers for risk classification. The values of these laboratory tests were relatively closely related to the intensity of COVID-19. Careful monitoring of early and late laboratory tests is crucial in patients' management to prevent preventable deaths (23).The relationship among laboratory components and reduced mortality has also been identified (24). These findings are useful for understanding the impacts of these components on the survival rate, as well as recognizing COVID-19 patients with the highest risk of death.

After perusing the patients' clinical symptoms, dry cough (60.9%), body ache (60%) and fever (50.1%) were classified as the most symptoms. Also, among the clinical symptoms, only fever was related to patients' need for mechanical ventilation (P = 0.33), while dry cough, body aches, shortness of breath, headache, and decreased olfactory and gustatory senseswere irrelevant with the mortality rate, ICU admission, length of hospitalization, and artificial respiration.

According to studies approved by the World Health Organization (WHO) and China Joint Mission on Coronavirus and Virus 2019 (25), the most common symptoms include fever (87.9%), dry cough (67.7%), fatigue (38.1%), sputum production (33.4%),shortness of

breath (18.6%), sore throat (13.9%), headache (13.6%), myalgia or arthralgia (14.8%), chills (11.4%), nausea or vomiting (5%), nasal congestion (84.8%), diarrhea (3.7%), hemoptysis (0.9%), and conjunctival congestion (0.8%).In most cases, the disease was mild and complete recovery was achieved. Among laboratory-confirmed COVID-19 patients, approximately 80% had mild to moderate disease, with or without pneumonia;13.8% had severe disease including shortness of breath, ≥ 30 breaths per minute, 93% peripheral oxygen saturation with or without pulmonary infiltration with more than 50% of the lung parenchyma in the first 24-48 hours;And 6.1% had severe disease that included respiratory failure and septic shock with or without multiple organ failure.Although asymptomatic infection has been reported, the proportion of asymptomatic cases has not been well established. Patients over 60 are apparently at higher risk of death, especially those with underlying diseases such as hypertension, diabetes, cardiovascular disease, chronic respiratory disease, and cancer (26, 25).The study of the relationship between clinical symptoms and prognosis of COVID-19 patients showed that the mortality and involvement rate in ICU patients is lower in those with anosmia (27).The relationship between headache and prognosis of COVID-19 patients also revealed that headache was a recurrent symptom in these patients and its presence was an independent predictor of reduced mortality risk (28).

By studying the effect of laboratory tests on patients' prognosis, Pourbagheri et al., reported that the value of laboratory parameters as simple biomarkers was a fast and cost-effective way to assess COVID-19 patients (29).

CONCLUSION

This study has several notable limitations. First, sufficient information about patients' demographics, clinical signs, history of exposure, and personal history were not provided. Second, it was a retrospective study relied on data collected from case records. Data such as which patient from which hospital was included in this study were not collected. Third, patients did not perform all laboratory tests including neutrophil count, lactate dehydrogenase, and serum ferritin.Therefore, the role of these tests in predicting death in hospitalized patients and its effect on their prognosis may be underestimated.Finally, this study focused on the short-term prognosis of COVID-19 patients during hospitalization, while the corona virus has just been discovered and research into its characteristics and prognosis is still ongoing.Therefore, the validity of risk factors for mortality in the current sample seemsweak. In fact, a larger sample and a longer follow-up period are needed to confirm these findings.To better understand the complications of COVID-19 and its clinical course of progression,future studies should include larger sample groups and assess the status of survived patients on the follow-up.

Perusing the laboratory indicators of CBS, LDH and CPK levels discover a positive relationship between thepatients' serum CPK levelsand mortality rate and length of hospitalization.Fever was also associated with the need for mechanical ventilation. The authors hope this information helps physicians treat COVID-19 patients.

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