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Predictor of Severity of Lung Injury and Oxygen Saturation in COVID- 19 Patients

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Wide spectrum of clinical features of COVID-19 was seen from mild to severe. This is very important to determine the severity of disease, early management of severe disorder may increase the chance of survival.
Methods: This cross sectional study perform on 150 patients with mean age of 53 years that refer to from 21 February to 19 April 2020.
Result: The most comorbidity disease HTN, DM and IHD with prevalence of 26.2%, 20%, 11.3% which had higher severity of lung disease. There was a significant relationship between age, lymphopenia, CRP, IHD, DM, shortness of breath and body pain with the severity of lung injury, shortness of breath had higher severity of lung injury but myalgia had a lower severity rather than the others. level of the LDH was associated with chest CT scan score and so severe disease

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Further results showed that the mean±SD of LDH in 3 CT group were 576.30±214.82, 641.89± 277.07, 919.92± 382.14 in CT score less than 20, 20-50 and more than 50 respectively (P=0.002). According this study there was significant relationship between age, BMI, CRP, shortness of breath and fever with blood oxygen saturation. Further results showed that the correlation between LDH and oxygen saturation was r=-0.31 (p=0.002)

Keywords: COVID-19; intensive care unit; Lactate Dehydrogenase; Body Mass Index.

1. INTRODUCTION

Several pneumonia cases consistent with the novel coronavirus infection, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), have been confirmed positive.Following the epidemic wave of the disease, the emergency ward and the intensive care unit (ICU) of hospitals were receptive to an influx of patients worldwide. Asymptomatic and mild symptoms have been reported for majority of Covid-19 cases while the minority of cases recorded as severe cases [1].

Many factors are possibly responsible for the severity of COVID-19 and hospitalization, e.g., hypertension, and underling diseases, older age, host, virus, and environment [2-6] are many uncertainties about risk factors responsible for severity of COVID-19 diseases and its associated hospitalization. The cohort studies may be better suited to resolve the questions raised by these uncertainties [7]. We attempted to answer some questions through a retrospective case-control study, where clinical characteristics of patients with moderate to severe COVID-19 evaluated for determining some essential factors affecting the susceptibility and disease severity of Covid-19 disease, resulting in identifying high-risk groups. The present study assessed the clinical and laboratory features and outcomes in patients with moderate to severe COVID-19 disease, to explore the risk factors affecting the susceptibility and disease severity.

Potential risk posed by medical states in hospitalized COVID-19 patients can be considered as a framework for interventions and evidence-based decision-making, leading to reduction of the morbidity and mortality associated with the disease and the additional burden imposed on families, hospitals, and health systems.

2. MATERIALS AND METHODS

A single-centered, cross sectional study was carried out on 150 COVID-19 patients hospitalized in Baqiyatallah hospital (Tehran, Iran) from 21 February to 19 April 2020. Patients who met the inclusion criteria were selected in this study. The inclusion criteria were, 1-hospitalized from 21 February to 19 April 2020, 2-Age ranges from 16 to 100, 3-approved diagnosis of COVID-19 by means positive RT-PCR of throat-swab specimens or the chest CT scans according to the WHO interim guidance including ground glass opacity in addition to ill-defined margins, smooth or irregular interlobular septal thickening, air bronchogram, crazy-paving pattern, and thickening the adjacent pleura [8-10] 4-Despite any uncontrolled mellitus diabetes history.

of gastrointestinal bleeding and pregnancy or lact ation. Patient unwilling to participate in study or high missing information in medical records were excluded.

The demographics, i.e., age, sex, Body Mass Index (BMI) in addition symptoms (e. g. shortness of breath, dry cough, cough, chest pain, throat pain , fever , shaking , myalgia), comorbidity (e.g., Ischemic Heart Disease (IHD), Diabetes Mellitus(DM), Asthma, Chronic obstructive pulmonary disease (COPD)), Laboratory (Lactate Dehydrogenase (LDH) , lymphocyte), Imaging features (CT scan score described by Pan et al (18) in addition vital sign (oxygen saturation) were evaluated.

The body temperature was determined with a digital thermometer (Omega Engineering Ltd., Manchester, UK) with a precision of ±0.1°C.

The statistical analysis was carried out using IBM SPSS version 18 a significant level of $p < 0.05$. Qualitative and quantitative variables were reported by frequency (percent) and mean ± Standard Deviation (SD), respectively. The distribution normality of quantitative variables was checked by the Kolmogorov Smirnov test. The Mann–Whitney U test or T-test, ANOVA or Kruskal Wallis test, Chi-square or Fisher's exact test were used to compare quantitative and qualitative variables between two groups, respectively.

3. RESULTS

This study was performed on 150 patients with COVID-19 with a mean age of 53 years and aSD of 15 years. The mean hospital stay was 5.44 days with a SD of 5.29 days. he distribution of demographic, clinical characteristics and comorbidity has been presented. ost of participants were male, in the age range of 41 to 60 years and with a BMI less than 40.Further results showed that the three underlying comorbidity diseases HTN, DM and IHD with prevalence of 26.2%, 20% and 11.3%, were the three most common comorbidity diseases among COVID-19 patients respectively, as well as symptoms such as shortness of breath, fever, dry cough and body aches and with prevalence of 71.7%, 60.7%, 60.0%, 56.3% and 49.7%, were the most in-hospital symptoms respectively.

In Table 2, Factors affecting the severity of lung injury based on CT scan score has been reported here was a significant relationship between age, Lymphopenia, CRP, IHD, DM, shortness of breath and body pain with the severity of lung injury. he severity of lung injury in older people was higher than younger ages, and also the severity of lung injury in abnormal Lymphopenia was higher than normal Lymphopenia. Also, further results showed that the severity of lung injury in patients , CRP was less than 20 and less than values higher than CRP 20. Patients with underlying IHD and DM had higher severity of lung injury. Finally, the results showed that people with shortness of breath had a higher severity of lung injury than others, but people with myalgia had a lower severity of lung injury rather than others patients.

Further results showed that the mean±SD of LDH in 3 CT group were 576.30±214.82, 641.89± 277.07, 919.92± 382.14 in CT score less than 20, 20-50 and more than 50 respectively (P=0.002)

In Table 3, factors affecting the blood oxygen saturation been reported. According to the information reported in this table, there was a significant relationship between age, BMI, CRP, shortness of breath and fever with theblood oxygen saturation. More results showed that, older people, patients with BMI above 40, CRP between 20 and 100, patients with shortness of breath and without fever had a lower mean of oxygen saturation than other patients. Further results showed that the correlation between LDH and oxygen saturation was r=-0.31 (P=0.002)

4. DISCUSSION

Many COVID-19 cases have been reported in Iran and other countries, where descriptive case series can provide data on the predictors or risk factors for hospitalization of COVID-19 patients and increased disease severity. We intend to evaluate data aboutclinical characteristics, laboratory results, and outcomes among COVID-19 confirmed cases, to explore the risk factors affecting the disease severity and hospitalization.

Many variables such as afebrile cases with chills and respiratory symptoms (e.g., dyspnea, etc.) have for developing a clinical algorithm in the early stages of COVID-19 outbreak in Wuhan, China, while high temperature was considered as a predictor of the disease due to lack of general presentation [11] The resultsshowed that the most prevalent symptom was shortness of breath (60.7%), followed by, fever, dry cough and body aches and chills.There was positive significant association between fever, cough, dyspnea, chills, dry cough and body aches with prevalence of COVID-19, which has remarkably increased the odds of hospital admission (OR=), indicating that febrile and afebrile patients with dyspnea could be triaged as having the highest priority level for hospitalization.

We determined risk factors affecting the severity of lung injury and hospitalization, where relationship of age, Lymphopenia, CRP, IHD, DM, shortness of breath and body pain with the severity of lung injury was found. with dyspnea (or even hypoxemia) seem to have a higher risk for hospital admission and have a higher risk of lymphopenia with lymphocyte count <1100/μL. Age over 61 years was found to be associated with severity of lung injury and hospital admission, while mild to moderate infection has been reported to be frequent in younger patients, thus, particular considerations should be taken regarding the elderly patients with COVID-19. This suggests that age is a risk factor for moderate to severe form of the disease. This could be related to a considerable frequency of comorbidities. Furthermore, this could be linked to the age-dependent decline in cell-mediated immunity and decrease humoral immune function [12] Patients who reported mild symptoms were on average younger compared to those with moderate to severe symptoms. with our results, previous studies reported association of age with severity of disease [13,14]. Age-associated defects of T-cell and B cell function and type 2 cytokine responses have been reported to linked

to difficulties in clearing microbial pathogens and prolonged proinflammatory responses, leading to poor outcome of the elderly patients [15,16].

Abnormal laboratory findings such as increased levels of CRP and lymphopenia was linked to severity of lung injury. CRP level has been defined to index for the continuation of inflammation, indicating the use of additional interventions [17]. In agreement with previous studies, lymphopenia is most commonly observed among COVID-19 patients that may be involved in cellular immune deficiency [18].

Our findings presented a history of diabetes among considerable proportion of the patients admitted to hospital. Pre-existing diabetes has been reported to be linked to higher risk of severe disease and in-hospital mortality among COVID-19 patients [19,20]. Diabetes isto be linked to increased risk of infections, resulting from multiple perturbations of innate immunity [21]. Multiple pathophysiological mechanisms such as compromised innate immune system, pro-inflammatory state and underlying pro-thrombotic hypercoagulable can be involved as derived from SARS-COV infection [22].

Table 1. The distribution of demographic, clinical characteristics, comorbidity and laboratory finding

Variable	Level	N	%
Gender	Male	103	68.7%
	Female	47	31.3%
Age	<= 40	38	25.5%
	41 – 60	67	45.0%
	61+	44	29.5%
BMI	Less than 40	138	93.2%
	More than 40	10	6.8%
Lymphopenia	Less than 1100	38	25.5%
	Normal	111	74.5%
CRP	Less than 20	106	71.6%
	20-100	38	25.7%
	More than 100	4	2.7%
IHD	No	133	88.7%
	Yes	17	11.3%
DM	No	120	80.0%
	Yes	30	20.0%
Asthma	No	148	98.7%
	Yes	2	1.3%
COPD	No	146	97.3%
	Yes	4	2.7%
HTN	No	110	73.8%
	Yes	39	26.2%
Shortness of breath	No	41	28.3%
	Yes	104	71.7%
Dry cough	No	58	40.0%
	Yes	87	60.0%
Sputum cough	No	125	86.2%
	Yes	20	13.8%
Chest pain	No	116	80.0%
	Yes	29	20.0%
Throat pain	No	126	86.9%
	Yes	19	13.1%
Fever	No	57	39.3%
	Yes	88	60.7%
Shaking	No	73	50.3%
	Yes	72	49.7%
Myalgia	No	63	43.8%
	Yes	81	56.3%

Table 2. Factors affecting the severity of lung injury based on CT scan score

Variable	Level	CT			P-value
		Less than 20 (n=59)	20-50 (n=59)	More than 50 (n=14)	
Gender	Male	44.9%	44.9%	10.1%	0.965
	Female	44.2%	44.2%	11.6%	
Age	<= 40	52.8%	44.4%	2.8%	0.001
	41 - 60	56.9%	34.5%	8.6%	
	61+	18.4%	60.5%	21.1%	
BMI	Less than 40	45.9%	43.4%	10.7%	0.579
	More than 40	30.0%	60.0%	10.0%	
Lymphopenia	Less than 1100	22.2%	48.1%	29.6%	0.001
	Normal	50.0%	44.2%	5.8%	
CRP	Less than 20	56.8%	37.9%	5.3%	0.001
	20-100	12.5%	62.5%	25.0%	
	More than 100	25.0%	50.0%	25.0%	
IHD	No	47.5%	44.9%	7.6%	0.04
	Yes	21.4%	42.9%	35.7%	
DM	No	49.5%	42.7%	7.8%	0.041
	Yes	27.6%	51.7%	20.7%	
Asthma	No	45.4%	44.6%	10.0%	0.143
	Yes	0.0%	50.0%	50.0%	
COPD	No	45.7%	43.4%	10.9%	0.150
	Yes	0.0%	100.0%	0.0%	
HTN	No	47.4%	44.2%	8.4%	0.292
	Yes	36.1%	47.2%	16.7%	
Shortness of breath	No	66.7%	28.2%	5.1%	0.006
	Yes	36.3%	50.5%	13.2%	
Dry cough	No	51.8%	39.3%	8.9%	0.435
	Yes	40.5%	47.3%	12.2%	
Sputum cough	No	47.3%	40.0%	12.7%	0.063
	Yes	35.0%	65.0%	0.0%	
Chest pain	No	42.6%	45.5%	11.9%	0.448
	Yes	55.2%	37.9%	6.9%	
Throat pain	No	43.8%	46.4%	9.8%	0.304
	Yes	55.6%	27.8%	16.7%	
Fever	No	45.1%	37.3%	17.6%	0.104
	Yes	45.6%	48.1%	6.3%	
Shaking	No	42.2%	42.2%	15.6%	0.210
	Yes	48.5%	45.5%	6.1%	
Myalgia	No	44.6%	35.7%	19.6%	0.015
	Yes	46.6%	49.3%	4.1%	

Table 3. Factors affecting the blood oxygen saturation

Variable	Level	Mean	SD	P-value
Gender	Male	90.68	6.10	0.249
	Female	89.25	8.33	
Age	<= 40	92.36	4.07	0.007
	41 - 60	90.83	6.57	
	61+	87.72	8.37	
BMI	Less than 40	90.73	5.84	0.006
	More than 40	84.33	14.71	
Lymphopenia	Less than 1100	88.66	8.61	0.096
	Normal	90.81	6.07	
CRP	Less than 20	91.09	6.00	0.023

Variable	Level	Mean	SD	P-value
	20-100	87.59	8.57	
	More than 100	92.67	5.13	
IHD	No	90.49	6.04	0.241
	Yes	88.41	11.40	
DM	No	90.80	6.08	0.058
	Yes	88.13	9.07	
Asthma	No	90.35	6.84	0.133
	Yes	83.00	4.24	
COPD	No	90.26	6.93	0.883
	Yes	89.75	4.11	
HTN	No	90.59	6.17	0.293
	Yes	89.23	8.51	
Shortness of	No	92.54	4.35	0.019
breath	Yes	89.50	7.47	
Dry cough	No	90.51	7.95	0.826
	Yes	90.25	6.12	
Sputum cough	No	90.52	6.96	0.484
	Yes	89.35	6.35	
Chest pain	No	90.40	6.07	0.876
	Yes	90.17	9.45	
Throat pain	No	90.51	5.90	0.482
	Yes	89.32	11.46	
Fever	No	88.75	9.30	0.024
	Yes	91.42	4.34	
Shaking	No	89.23	8.45	0.053
	Yes	91.47	4.60	
Myalgia	No	89.35	9.14	0.127
	Yes	91.14	4.11	

In agreement with our findings, cardiac complications and coronary artery are linked to poor outcomes of patients suffered from viral infections such as influenza and COVID-19 [23,24]. We found that the highest severity of lung injuy was rassciated with Ischemic heart disease, indicating that pre-existing cardiovascular disease is an important risk factor for these outcomes, the intensity of association varies depending on different definitions and severity of cardiovascular disease (e.g., coronary heart disease and heart failure etc.,).

5. CONCLUSION

We determined risk factors affecting the severity of lung injury, where our that increasing odds of disease severity related to age, Lymphopenia, CRP, IHD, DM, shortness of breath and body painare targets that should be taken in to consideration in the management of COVID-19. Increase severity of disease in high risk patients is associated with higher mortality rate and worsen prognosis , so we should have more attention and close observation in these group even if they had mild infection at first days because may developing to severe form of disease. This study may help to classification of Covid-19 disease , But we need more research to complete our information .

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

This study was approved by Human Ethics Committee of Baqiyatallah University of Medical Sciences (ethical code IR.BMSU.REC.1399.046).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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