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Evaluation of Initial Clinical Symptoms and Imaging Changes in Patients with COVID-19-Induced Pneumonia

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ABSTRACT

Introduction: The most common symptoms associated with the COVID-19 virus include fever, cough, lymphocytopenia, and specific changes in chest radiography. Given the novelty of this virus and the limited similar studies, this research was conducted to examine the correlation between clinical and laboratory findings in patients with community-acquired pneumonia and their association with radiologic findings. Methods: This descriptive study was conducted on patients admitted to Vali-Asr Hospital in Qaemshahr in 2021 with a diagnosis of pneumonia due to COVID-19. Demographic information, history of underlying disorders, type of pneumonia, immunodeficiency status, laboratory findings, history of pulmonary diseases, timing of radiography/CT scan, duration of hospitalization, and location of hospitalization (general ward or ICU) were extracted from medical records and collected according to the attached checklist. Results: The average age of the participants was 23.8 years, with 8% being female and 32.2% male. Various health conditions were observed among the patients, including diabetes (30.2%), hypertension (41%), dyslipidemia (29.3%), and chronic kidney disease (18.5%). Key findings indicate that 9.3% had low oxygen levels, with an average oxygen saturation of 95.19%. Most patients (93.7%) recovered, while 6.3% died. Common clinical symptoms included fever (73.7%), decreased consciousness (85.4%), and anxiety (82.4%). Consciousness scores were lower in patients with hypertension, dyslipidemia, and depressive symptoms. Finally, the length of hospitalization varied by ward, with patients in general wards having longer stays than those transferred to the ICU or operating room. Discussion: The findings indicate that factors such as age, gender, comorbidities, and diagnostic methods can significantly impact clinical outcomes and prognosis.

Key words: COVID-19, Pneumonia, Imaging, Clinical symptoms

INTRODUCTION

In late December 2019, an outbreak of pneumonia with an unknown cause was reported in Wuhan, the largest city in Hubei Province, China, which quickly spread to other regions. Subsequent investigations identified a new type of coronavirus as the causative agent, named SARS-CoV-2 by the World Health

Organization, with the resulting disease designated as COVID-19. On March 11, 2020, the World Health Organization declared COVID-19 a pandemic. According to the organization's weekly reports, by August 2021, the number of identified cases of COVID-19 worldwide had surpassed 200 million, with over 4 million deaths. In Iran, during the same period, over 4 million cases and more than 95,000 fatalities were reported (1).

Most patients exhibit mild symptoms such as fever, cough, sore throat, and muscle pain, although the disease presents severely in some cases, potentially leading to multi-organ failure, acute respiratory distress syndrome, pulmonary edema, and pneumonia. Lung imaging studies have shown that the most common findings include parenchymal ground glass and consolidation opacity, typically distributed in peripheral regions of the lungs. However, lung imaging may appear normal in early stages or milder cases (2). From a laboratory perspective, lymphopenia is observed in most COVID-19 patients, aiding in diagnosing new infection cases. Additionally, elevated levels of D-dimer, lactate dehydrogenase, troponin, CRP, and thrombocytopenia are frequently detected in a significant number of patients (3).

Given the high severity and mortality rate associated with COVID-19, it constitutes a critical health threat. Since no definitive cure for COVID-19 currently exists and most treatments are supportive, rapid diagnosis and prevention are crucial. Furthermore, due to the widespread epidemic of COVID-19 globally, particularly in Iran and Gilan Province, and given the limited information on the epidemiology and clinical findings of the disease, we aimed to examine the demographic, clinical, laboratory, and imaging characteristics of critically ill patients admitted to intensive care units of hospitals in Rasht over one month in March 2020. The findings from this study could serve as a guide for more effective responses to COVID-19, which continues to spread worldwide.

METHODS

This study is a descriptive cross-sectional analysis with the ethical code number IR.IAU.SARI.REC.1401.287. The statistical population consists of 205 patients admitted to Vali-Asr Hospital in Qaem Shahr, diagnosed with pneumonia due to COVID-19 in 2021, who were hospitalized in the general intensive care unit and the COVID-19 ward. Data collection was conducted from the patient's medical records. After enrolling eligible patients in the study, demographic information, medical history of underlying disorders, type of pneumonia, immunocompromised status, laboratory findings, history of respiratory diseases, timing of imaging (X-ray or CT scan), duration of hospitalization, and the location of hospitalization (general ward or ICU) were extracted and compiled based on a standardized checklist from their medical records. The inclusion criteria for the study included a confirmed diagnosis of pneumonia due to COVID-19 and completion of imaging. The exclusion criteria involved lack of access to the patient's medical file or incomplete records. The obtained data were analyzed using SPSS version 26 through descriptive statistical indicators (frequency and percentage) and analytical indicators (mean and standard deviation). A p-value of less than 0.05 was considered statistically significant.

RESULTS

The results regarding the demographic characteristics of the patients are presented in **Table 1**. The age group with the highest frequency was between 76 and 85 years, while the lowest frequency was observed in the 36 to 45 years age group. Among the participants, 67.8% were female and 32.2% were male. Additionally, 30.2% of the individuals had diabetes, while 69.8% did not. Hypertension was reported in 41% of the participants, and 29.3% had dyslipidemia. Furthermore, 18.5% of the individuals were diagnosed with chronic lung disease, and 9.3% had malignancies. Regarding immune status, 88.3% of the patients had a normal immune level, whereas 11.7% exhibited lower-than-normal immune levels. The mean blood oxygen saturation level among the patients was 95.19 ± 2.19. With 95% confidence, we can state that the

mean oxygen saturation level of the patients in the statistical population lies between 94.88 and 95.49.

Table 1. Demographic characteristics

Variables		Number	(%)
Age	<10	12	5.9
	11-20	18	8.8
	21-30	6	2.9
	31-40	18	8.8
	41-50	30	14.6
	51-60	31	15.1
	61-70	42	20.5
	71-80	24	11.7
	81-90	18	8.8
	>90	6	2.9
Gender	Male	66	32.2
	Female	139	67.8
Diabetic	Yes	62	30.2
	No	143	69.8
High blood pressure	Yes	84	41
	No	121	59
Dyslipidemia	Yes	60	29.3
	No	145	70.7
Chronic lung disease	Yes	38	18.5
	No	167	81.5
Malignancy	Yes	19	9.3
	No	186	90.7
Inpatient ward	Public ward	191	93.2
	ICU	14	3.4
	Emergency	7	3.4
Immune system	Normal	181	88.3
	< Normal	24	11.7
Final stage	Discharge	192	93.7
	Death	13	6.3

Table 2 illustrates the results related to clinical symptoms at the time of admission and imaging changes. Among the studied population, 151 individuals (73.7%) presented with fever, while 175 patients (85.4%) exhibited normal levels of consciousness. Additionally, 169 individuals (82.4%) experienced shortness of breath, and 21% reported gastrointestinal issues. The most significant imaging changes observed were between 25% and 50%.

Table 2. Frequency of clinical symptoms and medical imaging changes

Variables		Number	(%)
Fever	Yes	151	73.7
	No	54	26.3
Consciousness	Normal	175	85.4
	Reduced	30	14.6
shortness of breath	Yes	169	82.4

	No	36	17.6
Gastrointestinal symptoms	Yes	43	21
	No	162	79
Medical imaging changes	<25	6	2.9
	25-50	84	41
	50-75	36	17.6
	>75	79	38.5

Clinical findings and imaging changes in patients with COVID-19 pneumonia based on underlying diseases (diabetes, hypertension, immunodeficiency, asthma, and chronic obstructive pulmonary disease) are shown in **Table 3**. The results indicated no significant association between fever and hypertension or dyslipidemia, with fever occurring significantly less frequently in diabetic individuals. Moreover, the level of consciousness was significantly lower in patients with hypertension and dyslipidemia. No significant relationships were found between shortness of breath, gastrointestinal symptoms, and any of the underlying diseases. Additionally, there was no significant difference in imaging findings related to hypertension or dyslipidemia. However, in cases of diabetes, the imaging changes were significantly more pronounced.

Table 3. Investigating the relationship between fever and clinical symptoms

Variables		Fever		Consciousness		Shortness of breath		Gastrointestinal symptoms		Medical imaging changes	
		Yes	No	normal	reduced	Yes	No	Yes	No	number	mean
Diabetic	Yes	26	36	56	6	54	8	6	56	62	3.38
	No	125	18	119	24	115	28	37	106	143	2.71
P-value		0.001		0.186		0.248		0.061		<0.001	
High blood pres	Yes	49	35	60	24	71	13	12	72	84	3.07
	No	102	19	115	6	98	23	31	90	121	2.

sure											80
P-value		0.235		<0.001		0.513		0.05		0.06	
Dyslipidemia	Yes	35	25	43	17	48	12	6	54	60	2.93
	No	116	29	132	13	121	24	37	108	145	2.91
P-value		0.241		<0.001		0.555		0.142		0.93	

The analysis of clinical findings and imaging changes based on oxygen saturation levels revealed that blood oxygen levels were significantly higher in patients with fever **(Table 4)**. Furthermore, results demonstrated that patients with normal levels of consciousness had significantly higher oxygen saturation, whereas those experiencing shortness of breath had significantly lower levels. No significant association was found between blood oxygen levels and gastrointestinal symptoms. To evaluate the correlation between blood oxygen levels and CT scan changes, the Spearman correlation was employed, yielding a correlation coefficient of -0.587. This indicates a strong negative correlation, suggesting that as CT scan changes increase, blood oxygen levels decrease. **Table 4** further indicates that there is no significant correlation between gender, level of consciousness, or gastrointestinal symptoms with fever. Additionally, Pearson's chi-square test results revealed that shortness of breath was significantly more common in men than in women. The Mann-Whitney test was utilized to assess the relationship between age, imaging changes, and gender. Although the changes were slightly more pronounced in women, there was no significant difference between men and women.

Table 4. Investigating the relationship between oxygen level and sex and clinical symptoms

Variables		Number	Oxygen level	P-value	Sex		P-value
					Male	Female	
Fever	Yes	151	95.4±2.1	0.001	48	103	0.835
	No	54	94.3±2.1		18	36	

Consciousness	Normal	175	95.5±1.9	<0.001	60	115	0.122
	Reduced	30	93±2.2		6	24	
Shortness of breath	Yes	169	94.9±2.1	<0.001	60	115	0.028
	No	36	96.3±1.8		6	24	
Gastrointestinal symptoms	Yes	43	95.4±2.4	0.317	12	54	0.498
	No	162	95.4±2.1		31	108	
Medical imaging changes	Number	205	-0.507*		66	139	0.051
	Mean± SD	-	-	-	2.63±0.8	3.05±0.9	

* Pearson coefficient

Findings presented in **Table 5** showed that fever was significantly more prevalent among younger individuals. Additionally, the level of consciousness was significantly higher in the younger age group. However, no significant correlations were observed between shortness of breath, gastrointestinal symptoms, and age. Spearman correlation analysis regarding age and CT scan changes revealed a correlation coefficient of 0.336, indicating a moderate positive correlation, which suggests that as the age of the patient increases, so do the CT scan changes. **Table 5** also indicates that there is no significant correlation between fever, level of consciousness, or gastrointestinal symptoms with the duration of hospitalization. Conversely, the results for shortness of breath were different, with shortness of breath being significantly more common in individuals who were hospitalized for a longer duration. The correlation coefficient of -0.176 indicated a moderate negative correlation between hospitalization duration and CT scan changes, implying that as the length of hospitalization increases, CT scan changes decrease.

Table 5. Investigating the relationship between age and duration of hospitalization and clinical symptoms

Variables	age		p-value	Duration of hospitalization		p-value
	number	mean±sd		number	mean ±sd	

Fever	Yes	151	49.2 ±21.6	< 0.001	151	5.9 ±1.8	0.072
	No	54	64.3 ±26.3		54	5.4 ±1.8	
Consciousness	Normal	175	49.8 ±23.5	< 0.001	175	5.8 ±1.7	0.545
	Reduced	30	73± 14.3		30	5.5 ±2.5	
Shortness of breath	Yes	169	53± 23.6	0.814	169	5.9 ±1.9	0.008
	No	36	54.1 ±25		36	5.3 ±1	
Gastrointestinal symptoms	Yes	43	47.9 ±28.7	0.10	43	5.4 ±2	0.138
	No	162	54.6 ±22.2		162	5.9 ±1.8	
Medical imaging changes	Number	205	0.336*	< 0.001	205	-0.137*	0.012

* Pearson coefficient

Findings in **Table 6** demonstrate a significant correlation between the ward of hospitalization and fever, with higher instances of fever observed in patients admitted to the general ward compared to those in the ICU and emergency departments. Additionally, there was a significant relationship between the ward of hospitalization and the level of consciousness; patients in the general ward exhibited higher levels of consciousness than those in the ICU and emergency department. In this study, no significant correlation was found between the ward of hospitalization and shortness of breath. Furthermore, gastrointestinal symptoms were more prevalent in patients admitted to the emergency department compared to other wards. Imaging changes were significantly less in patients in the general ward compared to those in the emergency department and ICU, with no significant difference in imaging changes between patients in the ICU and emergency departments.

Lastly, findings in **Table 6** revealed that there was no significant correlation between treatment outcomes, shortness of breath, and imaging changes with fever. However, a significant relationship was found between gastrointestinal symptoms and treatment outcomes, indicating that patients who died exhibited more gastrointestinal symptoms compared to those who were discharged.

Table 6. Investigating the relationship between the stage of hospitalization and clinical symptoms

Variables	Stage of hospitalization		Final stage	

		General	ICU	Emergency	p-value	Discharge	Death	p-value
Fever	Yes	149	1	1	<0.001	144	7	0.094
	No	14	6	6		48	6	
Consciousness	Normal	175	0	0	<0.001	168	7	0.001
	Reduced	16	7	7		24	6	
Shortness of breath	Yes	156	7	6	0.445	156	13	0.086
	No	35	0	1		36	0	
Gastrointestinal symptoms	Yes	37	0	6	<0.001	31	12	<0.001
	No	154	7	1		161	1	
Medical imaging changes	number	191	7	7	0.005	192	13	0.986
	mean±sd	2.8±0.9	3.6±0.7	3.7±0.7		2.9±0.9	2.9±1	

DISCUSSION

The novel coronavirus (COVID-2019) is classified among coronaviruses and is a single-stranded RNA virus with an enveloped structure that is heat-sensitive. Evolutionary studies have indicated that this virus originates from animals such as bats, rodents, and birds (4). In early December 2019, the first case of pneumonia with an unknown cause was observed in Wuhan, the capital of Hubei province (5). The pathogen responsible for this disease, which was an enveloped RNA coronavirus (6), was designated as "Severe Acute Respiratory Syndrome Coronavirus 2" (SARS-CoV-2). The pathological course of the disease caused by this virus is somewhat similar to that of Severe Acute Respiratory Syndrome (SARS) (7). Based on previous studies, common manifestations caused by this virus include a high fever exceeding 37.5 degrees Celsius (56.2%), cough (67.8%), lymphocytopenia (83.2%), and ground-glass opacities observed in chest radiography (56.4%). It is also possible for the disease to present without fever, with many patients lacking unusual radiological findings (8). Given the emerging nature of this virus and the lack of similar descriptive studies in Vali Asr Hospital, we aimed to investigate the correlation between clinical and laboratory findings in patients with community-acquired pneumonia and their relationship with radiological findings in a study. We will first examine the results obtained from the current study and then compare these results with other studies.

The findings of the present study indicated that the mean age of participants was 53.25 ± 23.82 years. Eight percent were women and 32.2% were men. 30.2% had diabetes, while 69.8% were non-diabetic. Forty-one percent had high blood pressure, 29.3% had dyslipidemia, and 18.5% had chronic kidney disease. 9.3% had low oxygen levels. 88.3% of participants had normal immune levels, while 11.7% had below-normal levels. The mean oxygen level in patients was 95.19 ± 2.19, and we can state with 95% confidence that the mean oxygen level in the population is between 94.88 and 95.49. Patients were hospitalized for an average of 5.81 ± 1.87 days, with a 95% confidence interval indicating that the mean of this indicator in the population is between 5.56 and 6.04. 93.7% of patients recovered, while 6.3% died. 151 individuals studied had a fever, equivalent to 73.7% of the study population. 175 individuals experienced decreased consciousness, constituting 85.4% of the study population. Additionally, 8.6% experienced altered consciousness. 169 individuals in the study reported anxiety symptoms, representing 82.4% of the population studied. Six individuals (approximately 2.9%) exhibited changes of less than 25%, 84 individuals (around 41%) showed changes between 25% and 50%, 36 individuals (about 17.6%) demonstrated changes between 50% and 75%, and 79 individuals (38.5%) had changes exceeding 75%. No significant relationship was found between cough and high blood pressure, dyslipidemia, or diabetes. The results indicated significant relationships between oxygen saturation and both high blood pressure and dyslipidemia, as well as between depression symptoms and four health conditions studied. However, no significant differences in imaging findings were observed based on the presence or absence of these health conditions among patients. Imaging results between diabetic and non-diabetic patients differed significantly, with greater changes observed in the former. Furthermore, oxygen saturation levels were higher in patients who tested positive for COVID-19 compared to those who had negative results. Consciousness scores were lower in patients with high blood pressure, dyslipidemia, and depressive symptoms. No significant correlation was found between imaging results and gender or age. The duration of the fever was longer in male patients, but no other demographic factors affected the duration of the fever. Finally, the length of hospital stay significantly varied by department, with patients admitted to general wards staying longer than those transferred to the ICU or operating room.

Now we will compare the results obtained from the current study with other studies. The comparative analysis of various findings in today's world has given special importance to medical and scientific research due to the outbreak of infectious diseases such as COVID-19. This article examines and compares the results

of several prominent studies regarding COVID-19, analyzing the relationships and differences between our study and these investigations. The objective of this comparison is to provide a deeper understanding of factors that may influence the clinical features, symptoms, and prognosis of patients.

For instance, in the study by Bernaheim and colleagues, the mean age of patients was reported as 56.6 years with a standard deviation of 13.7, indicating an older age group compared to our study, which had a mean age of 53.25 ± 23.82. Moreover, while our study had a lower percentage of participating men at 32.2%, Bernaheim et al. (2020) reported a higher percentage of 47.1%. Notably, the prevalence of high blood pressure and diabetes in our study was higher than that reported in Bernaheim's study, while issues such as dyslipidemia and chronic kidney disease (CKD) were not addressed in their research. Additionally, we observed a shorter time interval between the first chest CT scan and symptom onset in our study, which may have impacted the identification and analysis of lesions (9).

Similarly, the study by Chung et al. (2019) addressed the wide age range of patients; however, our study included a larger patient cohort, resulting in stronger statistics. In both studies, the percentage of women remained around 8%. Nevertheless, the prevalence of diabetes and high blood pressure was greater in our study. Furthermore, while Chung's study focused on imaging features, our research analyzed the relationships between physiological parameters and symptoms (5).

In comparison, the study by Guan et al. (2020) reported a mean age similar to ours (47.0 ± 15.0); however, our study included a higher percentage of women (32.2% vs. 8.6%) (8). Furthermore, Guan et al. noted higher rates of comorbidities, particularly diabetes, hypertension, and cardiovascular diseases, compared to our findings. Additionally, differing classification criteria may lead to varying interpretations of results. Our study highlighted specific complications such as anosmia and ageusia, which were not identified in Guan's research. When comparing our findings with those of Pan et al. (2020), we found that the mean age in our study was lower (43 years vs. 63 years) (10). Our participants exhibited various stages of infection; however, the mortality rate was notably higher in our investigation (6.3% vs. 1.4%). Furthermore, no relationship was observed between age or gender and survival probability in our study, contrasting with Pan et al.'s findings. In the research conducted by Feng and colleagues, RT-PCR tests were performed alongside CT scans, revealing a discrepancy between these two diagnostic methods regarding accuracy. They reported moderate sensitivities for both RT-PCR (59%) and CT scan (88%). Conversely, the primary aim of our study was to explore the relationships between physiological indicators, symptoms, and prognosis.

In the study by Shi et al. (2020), the difference in mean age was markedly evident (63.1 ± 14.3 vs. 53.25), as was the gender ratio (55.3% male vs. 32.2%) (11). Their classification of disease severity allows for direct comparisons of outcome measures, revealing a higher percentage of severe and critical cases (61.5% vs. 6.3%). In terms of radiological aspects, bilateral and patchy opacities predominated in Shi's study, while our study emphasized hypoxemia and physiological symptoms. Furthermore, Zhou et al.'s study highlighted different age and gender categories (mean age 56 vs. 53.25) and included a higher percentage of men (56.5% vs. 32.2%) (7). Critical patients constituted a significant portion of their study group (31.7%). The primary causes of death also varied among studies: acute respiratory syndrome was the predominant cause in Zhou's study, whereas multi-organ failure was a consideration in ours. Lastly, in the study by Li et al. (2020), a larger number of older participants were included (mean age 58.5 vs. 53.25), and a higher percentage of men (62.5% vs. 32.2%) (12). Their research also revealed that severe cases constituted a major portion of patients (75.5% vs. 6.3%). Multiple regression models were employed to identify risk factors associated with outcomes, with CD4+ T cell counts recognized as a strong predictor of mortality.

CONCLUSION

Ultimately, the comparison among various studies in the field of COVID-19 reveals significant diversity in

demographic characteristics, prevalence of diseases, and research methodologies. This review indicates that factors such as age, gender, types of comorbidities, and diagnostic methods can have a substantial impact on clinical outcomes and prognoses. Therefore, to achieve a better understanding of the complications of the disease and optimize treatment methods, continued extensive research and interdisciplinary collaboration are essential.

REFERENCES

1. Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. Journal of medical virology. 2020;92(4):441-7.

2. Alimohamadi Y, Sepandi M, Taghdir M, Hosamirudsari H. Determine the most common clinical symptoms in COVID-19 patients: a systematic review and meta-analysis. Journal of preventive medicine and hygiene. 2020;61(3):E304.

3. Larsen JR, Martin MR, Martin JD, Kuhn P, Hicks JB. Modeling the onset of symptoms of COVID-19. Frontiers in public health. 2020;8:551338.

4. Liu Z, Magal P, Seydi O, Webb G. Understanding unreported cases in the COVID-19 epidemic outbreak in Wuhan, China, and the importance of major public health interventions. Biology. 2020;9(3):50.

5. Chung M, Bernheim A, Mei X, Zhang N, Huang M, Zeng X, et al. CT imaging features of 2019 novel coronavirus (2019-nCoV). Radiology. 2020;295(1):202-7.

6. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. The lancet. 2020;395(10224):565-74.

7. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. New England journal of medicine. 2020;382(8):727-33.

8. Guan W-j, Ni Z-y, Hu Y, Liang W-h, Ou C-q, He J-x, et al. Clinical characteristics of coronavirus disease 2019 in China. New England journal of medicine. 2020;382(18):1708-20.

9. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, et al. Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection. Radiology. 2020;295(3):685-91.

10. Pan F, Ye T, Sun P, Gui S, Liang B, Li L, et al. Time course of lung changes on chest CT during recovery from 2019 novel coronavirus (COVID-19) pneumonia. Radiology. 2020.

11. Shereen MA, Khan S, Kazmi A, Bashir N, Siddique R. COVID-19 infection: Emergence, transmission, and characteristics of human coronaviruses. Journal of advanced research. 2020;24:91-8.

12. Li X, Xu S, Yu M, Wang K, Tao Y, Zhou Y, et al. Risk factors for severity and mortality in adult COVID-19 inpatients in Wuhan. Journal of Allergy and Clinical Immunology. 2020;146(1):110-8.