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Clinical investigation of COVID-19 related pneumonia through HRCT chest scan

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Abstract

Coronavirus causes infections from moderate to severe such as SARS and MERS. The working of the heart, respiratory system and the number of respiratory disorders is the most severe effects of COVID-19. In most cases, novel corona virus may eventually cause death. Current study was planned to evaluate the symptoms caused by COVID-19 and damage of COVID-19 with respect of each lobe of both lungs. Chest CT scan (chest HRCT scans) was used to check the lungs damage caused by corona virus. In male patient's severity of COVID-19 was higher (Maximum HRCT score= 20) as compared to female patients (Maximum HRCT score= 16). With increasing of age severity of pneumonia also increased. In the age group 18-36 years, no individual was observed with severe COVID-19 while in older adults (37-80 years) 25% patients were observed with severe symptoms. COVID-19 cause more damage to left lung as compared to right lung. Among upper lobes and lower lobes of both lungs, SARS-CoV-II caused more damage to lower lobes (mean HRCT score lower lobe= 3.33±1.23; 3.17±1.47 for right and left lung respectively). The comparative analyses of both the lungs were performed and it was observed that the upper (mean HRCT score = 2.42±1.16) and lower lobe (3.33±1.23) of right lungs was more affected than left upper lobe (mean HRCT score =2.33±1.07) and lower lobe (3.17±1.47). Usually, COVID-19 affects the lungs leads to serious consequences. Pneumonia was observed with little air sacs that make up the lungs become inflamed and fills with fluid. Pneumonia is more likely to attack both the lungs in COVID-19.



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Introduction

SARS-CoV-2 causes COVID-19, a pandemic throughout the world [1]. SARS-CoV-2 was first identified in Wuhan, China, and then spread throughout the world [2]. COVID-19 was declared as a pandemic by World Health Organization (WHO) on March 11, 2020 [3].

Corona viruses are RNA viruses belongs to Coronaviridae family having a genome of 31Kb [4, 5]. Corona viruses are pathogens found in pet animals and infecting the respiratory and intestinal tract of different host species mainly humans [4, 6, 7]. Corona viruses infect humans are generally classified into low pathogenic CoVs (HCoV-229E, HCoV-OC43, HCoV-NL63, and HCoV-HKU) and highly pathogenic CoVs (SARS and MARS) [8, 9]. COVID-19 has severe symptoms including fever, dyspnea, and dry cough [10]. All the 27 cases, reported initially, were from a wholesale market selling seafood, live bats, and snakes [11]. This virus transmits from these patients to healthy people very hastily and Wuhan city becomes the flashpoint of this pandemic. With increasing number of infected people day by day all across the world, corona virus becomes a global health threat [12].

Corona virus can cause infections such as SARS and MERS [13]. Malfunctioning of cardiovascular and respiratory system are the most severe effects of COVID infection and in most cases, it may eventually cause the death of the patient [14]. The effects of COVID-19 are not only limited to physiological, however also have psychological effects [15].

COVID-19 usually infects the lungs. SARS-CoV-2 causes severe viral pneumonia and infected >328 million individuals and caused more than 5.5 million deaths worldwide till January 17, 2022. Pneumonia leads to fill little air sacs lungs become inflamed and fill with fluid [16]. Pneumonia is more likely to attack both lungs in COVID-19. People who have big sections of their lungs impacted have trouble absorbing adequate oxygen and must be admitted to the hospital [17].

Acute respiratory distress syndrome (ARDS), known as wet lung, is another serious side effect in which severe inflammation spreads swiftly throughout the lungs. People who develop this condition may require mechanical ventilation in an intensive care unit for an extended period of time [18].

COVID-19 has a unique effect on the human body. It causes significant clotting in the tiny blood vessels of the lungs and other organs as compared to other

respiratory viruses [19]. Corona virus affected millions of the people around the globe therefore the present study was designed to record the symptoms of COVID-19 related pneumonia, oxygen level, heart rate and lungs damage caused by corona virus.

Materials and Methods

Experimental Population

The confirmed patients of COVID-19 were selected for current research.

Experimental design

Chest CT Scan (chest HRCT scans 5mm axial view) without contrast was used to check the lungs damage caused by corona virus in corona patients [20].

Data Collection

The confirmed patients were examined for symptoms and their heart rate and oxygen level were recorded. Further patients were requested for Chest CT Scan test (chest HRCT scans 5mm axial view) and reports were collected for further analyses.

HRCT Score Analysis

HRCT score ranges from 1 to 5 as 1 (5% or less), 2 (5%-25%), 3 (26%-49%), 4 (50%-75%) and 5 (76%-100%). Severity level of pneumonia was classified as Mild (7 or less), Moderate (8-17) and sever (18-25) [20] (**Fig. 1**).

Statistical analysis

The statistical analyses were performed by using Minitab (Version 24). The descriptive statistics were applied to CT score, a result of less than 0.05 was considered statistically significant.

Results

Baseline Information

The selected patients were suffering from different symptoms of pneumonia and COVID-19. The shortness of breathing (SOB), cough, dry cough, cough with sputum, fever, chest pain, basal crepitation (B/L CREPTS), diabetes mellitus (DM),

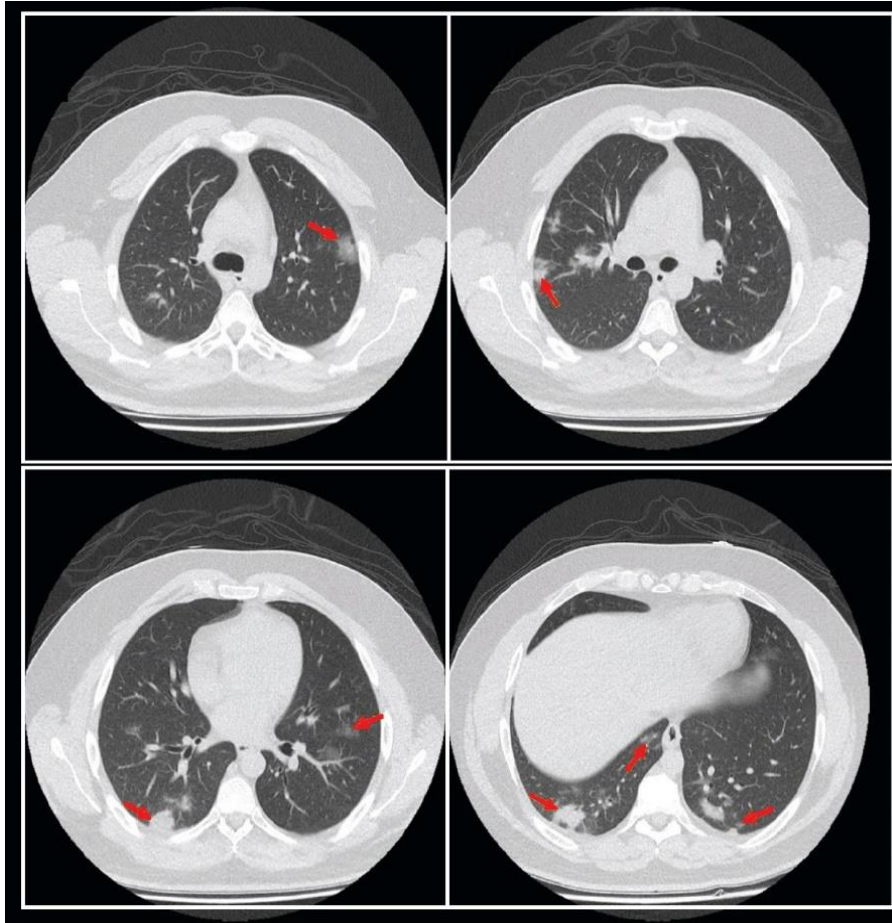


Fig. 1: HRCT image indicating the presence of CORONA virus in lungs

hypertension (HT⁺), sever weakness and body pain were included.

Demography of the patients

Data was collected from 12 patients from which 66.66% (8/12) were male patients and 33.33% (4/12) were female patients. Patients were grouped into two age groups as 18-36 years 33.33% (4/12) and 37-80 years 66.66% (8/12). Most of the patients were in normal range of BMI and few patients 33.33% were over weighted (**Table 1**).

Symptoms, oxygen saturation level and HRCT score of patients

Patients were suffering from different symptoms of pneumonia and COVID-19 and oxygen saturation level of patients was less than normal and patients with oxygen level of 92 or below were on ventilators. HRCT score described the severity of COVID-19 in patients. Moderate severity of pneumonia was observed in most of the patients (**Table 2**).

Table 1: Demographic characteristics of selected patients

Patients	Gender	Age (Y)	BMI score
P1	Male	25	24.7
P2	Male	50	22.1
P3	Male	25	32
P4	Female	65	28.5
P5	Male	32	26
P6	Female	42	23.1
P7	Male	48	24.7
P8	Male	70	21.8
P9	Female	60	19.6
P10	Male	40	23.9
p11	Male	29	26.1
P12	Female	41	25

Gender base mean HRCT score

Minimum-maximum range of HRCT score along with mean values was observed. In male patients, the severity of COVID-19 was higher (Maximum HRCT score= 20) as compared to female patients (Maximum HRCT score= 16) however, mean value of HRCT score was higher for female patients (mean HRCT= 13.25) than male patients (mean HRCT= 12.74) (**Table 3**).

Table 2: Medical condition of patients

Patients	SpO ₂ %	HRCT score	Symptoms
P1	92	14	SOB, fever, sever cough, itching, body pain
P2	91	11	SOB, cough with sputum, B/L CREPTS
P3	93	7	SOB, fever, cough, B/L CREPTS
P4	90	14	HT ⁺ , DM, fever, SOB, dry cough, chest pain, B/L CREPTS
P5	89	16	SOB, fever, sever cough, chest pain, B/L CREPTS
P6	94	4	Fever, cough, SOB, hypertension, DM,
P7	92	10	SOB, cough with sputum, B/L CREPTS
P8	93	10	High grade fever, SOB, dry cough
P9	91	16	SOB, cough, fever, B/L CREPTS
P10	88	20	Hypertension, fever, SOB, dry cough, chest pain
p11	92	14	SOB, fever, sever cough, itching, body pain
P12	94	14	SOB, cough, fever, B/L CREPTS

Pneumonia severity index

Pneumonia severity index was observed in selected patients (Table 4). There were no significant ($P > 0.05$) differences in pneumonia symptoms based on gender in COVID-19 patients. The generated data showed that with the increase of age, the severity of pneumonia also increased. At the young age group (18-36 years) no individual was at severe level of COVID-19 pneumonia while in older adults (37-80 years) 25% patients were at severe level of COVID-19 pneumonia (Table 4).

Table 3: Gender base mean HRCT score

Gander	N	HRCT (Min-Max)	Mean	Std.
Male	8	7-20	12.74	4.09
Female	4	4-16	13.25	5.62

Table 4: Pneumonia severity index

Demographic Character	Mild	Moderate	Sever	P-value
Gender				
Male	12.5%	75%	12.5%	0.25
Female	25%	50%	50%	
Age				
18-36	25%	75%	0	0.13
37-80	12.5%	62.5%	25%	

Damage to lungs

It was observed that the COVID-19 pneumonia causes more damage to left lung as compared to right lung (Table 5). Among upper lobes and lower lobes of both the lungs, SARS-CoV-2 caused more damage to lower lobes (mean HRCT score right lung lower lobe= 3.33 ± 1.23 ; mean HRCT score left lung lower lobe= 3.17 ± 1.47). Comparison between lowers lobes of both lungs indicated that the lower lobe of right lung was more damaged. When upper lobes of both lungs were compared, right upper lobe was more damaged (Mean HRCT score = 2.42 ± 1.16) than left

upper lobe (Mean HRCT score = 2.33 ± 1.07) (Table 5).

Discussion

SARS-CoV-2 causes infections from moderate to severe such as SARS and MERS [13]. The working of the heart and respiratory system and the number of respiratory disorders are the most severe effects of COVID-19 infection and in most cases, it may eventually cause the death of the patient [14]. The effects of COVID-19 infection are so adverse that they are not only limited physically but they also affect the psychological conditions of the individual [15].

The scarring of the lungs might occur in severe conditions of infection. It is possible that scarring could result in stiffness in the lungs, which will make it more difficult to breathe and deliver oxygen to the circulation, resulting in long-term dyspnea and difficulties doing everyday chores.

The patients infected by SARS-CoV-2 experience a number of symptoms and health issues. Various symptoms of COVID-19 were observed in current study including shortness of breathing (SOB) [21], cough, dry cough [22], cough with sputum, fever [23], chest pain [24], basal crepitation (B/L CREPTS) [25], diabetes mellitus (DM), Hypertension (HT⁺), severe weakness and body pain [26]. It was observed that the oxygen saturation level of patients was less than normal patients with oxygen level of 92 or below were on ventilator and artificial oxygen [27] were utilized. In current study, HRCT score was used to describe the severity of COVID-19 pneumonia in patients. Most of the patients were on moderate level of severity of pneumonia.

Younger adults (18-36 years) were not suffering from severe level of COVID-19 related pneumonia however, older adults were suffering from severe level of COVID-19 related pneumonia indicating that

Table 5: Lobe wise COVID-19 Pneumonia damage to lungs

Patients	Right Lung (HRCT score)			Left Lung (HRCT score)		Total HRCT score
	Upper lobe	Middle Lobe	Lower lobe	Upper lobe	Lower lobe	
P1	4	3	2	3	2	14
P2	1	1	4	1	4	11
P3	1	1	2	1	2	7
P4	4	2	3	3	2	14
P5	2	2	4	3	5	16
P6	1	0	1	1	1	4
P7	2	1	3	2	2	10
P8	2	1	3	2	2	10
P9	2	2	5	2	5	16
P10	3	3	5	4	5	20
P11	3	1	4	2	4	14
P12	4	3	4	4	4	19
Mean	2.42	1.67	3.33	2.33	3.17	12.92
Std.	1.16	0.98	1.23	1.07	1.47	4.72
P value	0.008					

increasing age is positively linked with severity of COVID-19 pneumonia [28]. Current study showed that in male patients, the severity of COVID-19 pneumonia was higher (Maximum HRCT score= 20) as compared to female patients (Maximum HRCT score= 16). Conclusively, the observed findings were closely related to [28]. COVID-19 pneumonia causes more damage to left lung as compared right lung. Among upper lobes and lower lobes of both lungs, COVID-19 virus caused more damage to lower lobes [29].

Conclusion

Thin-section CT could offer a semi-quantitative assessment of the severity of lung damage. Younger adults (18-36 years) were not suffering from severe level of COVID-19 related pneumonia however, older adults were suffering from high severe level of COVID-19 related pneumonia indicating that increasing age is positively linked with severity of COVID-19 pneumonia. COVID-19 pneumonia causes more damage to left lung as compared right lung. Among upper lobes and lower lobes of both lungs COVID-19 virus caused more damage to lower lobes.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication double publication and/or submission, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare no conflict of interest.

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