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Original Article

Initial COVID-19 Severity and Long-COVID Manifestations: An Observational Analysis

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Abstract

OBJECTIVE: New-onset or persistent symptoms beyond after 4 weeks from COVID-19 are termed "long-COVID." Whether the initial severity of COVID-19 has a bearing on the clinicoradiological manifestations of long COVID is an area of interest.

MATERIAL AND METHODS: We did an observational analysis of the long-COVID patients after categorizing them based on their course of COVID-19 illness into mild, moderate, and severe groups. The clinical and radiological profile was compared across these groups.

RESULTS: Out of 150 long-COVID patients recruited in the study, about 79% (118), 14% (22), and 7% (10) had a history of mild, moderate, and severe COVID-19, respectively. Fatigue ($P = .001$), breathlessness ($P = .001$), tachycardia ($P = .002$), tachypnea ($P < .001$), raised blood pressure ($P < .001$), crepitations ($P = .04$), hypoxia at rest ($P < .001$), significant desaturation in 6-minute walk test ($P = .27$), type 1 respiratory failure ($P = .001$), and type 2 respiratory failure ($P = .001$) were found to be significantly higher in the long-COVID patients with a history of severe COVID-19. These patients also had the highest prevalence of abnormal chest X-ray (60%) and honeycombing in computed tomography scan thorax (25%, $P = .027$).

CONCLUSION: The course of long COVID bears a relationship with initial COVID-19 severity. Patients with severe COVID-19 are prone to develop more serious long-COVID manifestations.

KEYWORDS: Walk test, breathlessness, respiratory failure, COVID-19
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INTRODUCTION

The ongoing COVID-19 pandemic has posed a significant challenge to healthcare workers. Not only this, but even after acute COVID-19, patients continue to suffer from persistent symptoms. New-onset or persistent symptoms, unexplained by alternate etiology, after 12 weeks of COVID-19 have been termed as "post-COVID" and after 4 weeks as "long-COVID."[1,2] The various clinical findings of long COVID include fatigue, breathlessness, cough, and chest pain.[3] Its radiological sequelae include ground-glass opacities and parenchymal bands.[4]

From the very beginning of the COVID-19 pandemic, periods of crest and trough in the positivity rate and number of active cases of the disease have been documented, but from then only, the healthcare system has been burdened with the ever-rising long-COVID cases. It has now become equally important to recognize long-COVID symptoms at the earliest and to manage them appropriately.

Studies have documented that even patients with mild or no symptoms at the time of COVID-19 positivity also suffer from long-COVID manifestations.[5,6] Most common manifestations include fatigue, cough, or exertional dyspnea.[3,7,8] The long-term implications of COVID-19 infection are still not well documented and this is an area of active research. Therefore, it is universally recommended to closely follow COVID-19-infected patients in the post-COVID period, for persistent or new symptoms.[9,10] In the present study, we analyzed the clinical, laboratory, and radiological parameters of 150 long-COVID patients who presented to us with persistent or newly developed respiratory symptoms. Simultaneously, we studied the clinicoradiological findings in long-COVID patients in relation to the severity of their acute COVID-19 illness.

MATERIAL AND METHODS

The present study is an observational analysis of the long-COVID patients presenting to the outpatient department of our hospital during the period May 2020 to December 2020. Patients with a diagnosis of "long COVID," that is, presenting with persistent symptoms (without alternate etiology) even after 4 weeks from the diagnosis of COVID-19 with alternate diagnosis having been excluded, were enrolled into the study.[1] Only patients with age >18 years were included in the

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study. The demographic profile, symptomatology, physical examination findings, and blood and radiological investigation of these patients were analyzed. Patients with (1) resting hypoxia (oxygen saturation SpO_2 <90%), (2) significant exertional desaturation (>4% fall in oxygen saturation) on 6-minute walk test (6MWT), or (3) evidence of any abnormality on chest radiograph were advised to undergo computed tomography scan (CT scan) of the chest and 82 patients qualified for the same.

All the CT scans were evaluated by 2 pulmonologists (with >28 years and >16 years of experience) and 1 radiologist (with >25 years of experience). For quantitative estimation of lung abnormalities on CT scan, a scoring system was used which relied on the basis of the area involved.[11,12] In this scoring system, each of the 5 lung lobes was visually scored on a scale of 0 to 5 as follows: (a) score 0 if no involvement, (b) score 1 if less than 5% involvement, (c) score 2 if 5%-25% involvement, (d) score 3 if 26%-49% involvement, (e) score 4 if 50%-75% involvement, and (f) score 5 if more than 75% involvement. The total CT severity score (CTSS) was derived by summation of individual scores of all 5 lobes, and hence, it ranged from 0 (no involvement) to 25 (maximum involvement).

We categorized the patients based on their course of COVID-19 illness into mild, moderate, and severe groups.[13] Patients with (a) a history of home isolation or hospital admission (without oxygen support) for monitoring only during COVID-19 were categorized as "mild," (b) a history of hospital admission requiring oxygen support as "moderate," and (c) a history of hospital admission for non-invasive (NIV) or invasive ventilation as "severe."

The patients presenting to us within 4 weeks period from COVID-19 were excluded from the study.

The study was approved by Institutional Human Ethics Committee of the Vallabhbhai Patel Chest Institute, University of Delhi (approval number: VPCI/DIR/IHEC/2020/1847) and informed consent was obtained from all the participants.

Statistical Analysis

The collected data were entered into a Microsoft excel spreadsheet. The data were imported and analyzed in Statistical Package for Social Sciences version 22 statistical software (IBM Corp.; Armonk, NY, USA). The variables pertaining to this study were summarized using frequency and percentages in the case of categorical variables, mean and standard deviation for quantitative normally distributed variables, and quantitative variables which are skewed were summarized using median and interquartile range. Statistical tests namely one-way analysis of variance, Kruskal–Wallis test, and chi-square test for trend were employed to analyze the data. *P* value less than .05 was considered statistically significant.

MAIN POINTS

- Parallel to the recovery from COVID-19, there has been a rise in patients with persistent or new-onset symptoms termed "long COVID," worldwide.
- We compared long-COVID manifestations among patients with different severity of COVID-19.
- Severe COVID-19 patients were found to have significantly higher as well as more severe clinical and radiological manifestations compared to patients with mild to moderate COVID-19.
- Hence, COVID-19 patients require a planned and meticulous approach for the management of long-COVID manifestations.

RESULTS

During the study period, 150 long-COVID patients presented to the hospital. A maximum number of patients belonged to mild group (n = 118; 78.68%) followed by moderate (n = 22; 14.67%) and severe (n = 10; 6.68%). The clinical characteristics and laboratory and radiological findings of the 3 groups are depicted in Tables 1-5. Approximately 85% of patients (n = 128) had 1 or more comorbidities. Hypertension and diabetes mellitus were the commonest comorbidities (n = 34; 22.67% each). Bronchial asthma with allergic rhinitis was the most common respiratory comorbidity (Table 1). It was found that most patients with respiratory comorbidities had only mild COVID-19 (nearly 70% each, $P = .001$). No significant difference in the prevalence of respiratory comorbidities and severity of COVID-19 illness was found. Among patients with non-respiratory comorbidities, maximum had moderate COVID-19 (about 72%, $P = .027$) with diabetes mellitus being the commonest comorbidity (nearly 63%, $P < .001$). Fatigue and breathlessness (n = 108; 72% and n = 106; 70.67%, respectively) were the most frequent symptoms reported followed by cough (n = 100; 65.67%) (Table 2). Fatigue and breathlessness were found to be significantly higher in the severe category ($P = .001$), while cough was the most commonly reported symptom in the moderate category (100%, $P = .003$). Severe category patients had a significantly higher incidence of tachycardia (40%, $P = .002$), tachypnea (40%, $P < .001$), raised blood pressure record (60%, $P < .001$), and crepitations on auscultation (40%, $P = .04$). Hypoxia at rest (40%, $P < .001$), significant desaturation in 6MWT (40%, $P = .27$), type 1 respiratory failure (20%, $P = .001$), and type 2 respiratory failure (20%, $P = .001$) all were significantly more common in the severe category. Six patients presented with respiratory failure and required hospitalization on presentation (Table 3). More than 40% of patients were anemic and 6 patients (4%) had raised blood sugars for the first time during the assessment. Severe category patients had statistically higher evidence of blood abnormalities in form of either neutropenia (40%, $P < .001$) or neutrophilia (20%, $P = .037$) and lymphopenia (40%, $P = .002$). As depicted in Table 4, chest radiograph was abnormal in about 53% of patients (n = 80) and bilateral diffuse reticulations was the most common abnormality detected (n = 38; 25.34%). On presentation, patients with a history of severe COVID-19 had the highest incidence of abnormal chest x-ray (60%) and diffuse reticulations were the commonest abnormality (60%, $P = .017$). As per the criteria stated above, 82 patients underwent a CT scan of the chest (Table 5). All these patients had abnormal CT scans (Figures 1 and 2). Most common findings were diffuse ground-glass opacities (n = 36; 43.9%) and diffuse reticulations (n = 32; 39.02%). Patients with severe

Table 1. Characteristics of Long-COVID Patients (n = 150)

	Overall (n = 150)	Mild (n = 118)	Moderate (n = 22)	Severe (n = 10)	*P**
Gender (male: female)	100:50	74:44	18:4	8:2	-
Age (mean ± SD) (in years)	46.56 ± 16.03	45.38 ± 16.54	54.18 ± 10.59	43.6 ± 15.47	.05
Duration to presentation (in days)** [Median (IQR)]	26 (10-71)	30 (12-83)	19 (8-53)	25 (15-37)	.296
Co-morbidities	n (%)	n (%)	n (%)	n (%)	
i. No comorbidities	22 (14.67)	36 (30.5)	10 (45.5)	8 (80)	.001
ii. Respiratory comorbidities	96 (64)	82 (69.49)	12 (54.54)	2 (20)	.001
a. Allergic rhinitis	14 (9.34)	12 (10.16)	2 (9.09)	0 (0)	.478
b. Bronchial asthma	8 (11.42)	8 (6.78)	0 (0)	0 (0)	.229
c. Bronchial asthma with allergic rhinitis	34 (22.67)	30 (25.42)	4 (18.18)	0 (0)	.06
d. Chronic obstructive pulmonary disease (COPD)	18 (12)	16 (13.56)	2 (9.09)	0 (0)	.209
e. Interstitial lung disease (ILD)	4 (2.67)	4 (3.39)	0 (0)	1 (0)	.5
f. Asthma—COPD overlap	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
g. Obstructive sleep apnea (OSA)	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
h. Active pulmonary tuberculosis infection	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
i. Past history of tuberculosis	14 (9.34)	10 (8.47)	4 (18.18)	1 (0)	.9
j. Bronchiolitis	2 (1.34)	0 (0)	0 (0)	2 (20)	.004
iii. Non-respiratory comorbidities	72 (48)	50 (42.37)	16 (72.72)	6 (60)	.027
a. Hypertension	34 (22.67)	24 (20.34)	6 (27.27)	4 (40)	.178
b. Diabetes mellitus	34 (22.67)	16 (13.56)	14 (63.63)	4 (40)	<.001
c. Coronary artery disease and dyslipidemia	10 (6.67)	6 (5.08)	4 (18.18)	0 (0)	.572
d. Hypothyroidism	8 (5.34)	6 (5.08)	0 (0)	2 (20)	.345

**P* value represents the statistical significance between mild, moderate, and severe groups; **Duration to presentation implies duration between: completion of 4 weeks from COVID-19 and the first presentation to our tertiary pulmonary center for consultation.
IQR, interquartile range; SD, standard deviation.

COVID-19 had the highest prevalence of honeycombing in CT scans (25%, *P* = .027). There was no statistically significant difference in the prevalence of other abnormalities on CT scans in the 3 groups, while most of the patients had a CT severity score of less than 8, nearly 25% (n = 20) had a score of more than 15.

DISCUSSION

Terms like "post-COVID," "long-haulers," and "long-COVID" have been used in the literature for patients who continue to have persistent or develop new symptoms even after "severe acute respiratory syndrome coronavirus 2" negativity (after alternate etiology for the same have been ruled out).[2] "National Institute for Health and Care Excellence" guidelines have defined "long-COVID" as signs or symptoms that continue or develop after 4 weeks from acute COVID-19 illness.[1]

We found that many patients (n = 86; 57.34%), despite having a history of mild COVID-19 illness only, presented with persistent symptoms along with clinical, laboratory, and radiological abnormalities (Tables 1-5). These findings were consistent with another study which found that "non-critical COVID-19 patients" had at least 1 persistent symptom of 68% on day 30 and of 66% on day 60 from acute COVID-19 illness.[14] Further, since our center is a tertiary care referral institute, we observed a high prevalence (85%) of comorbidities in the present cohort of long-COVID patients.

Similar to other studies,[3,5,15] we found fatigue, exertional dyspnea, and cough to be the most common long-COVID symptoms (Table 2). Long-COVID manifestations in the form of fatigue and dyspnea (*P* = .001), tachycardia (*P* = .002), tachypnea (*P* < .001), raised blood pressure (*P* < .001), and crepitations on auscultation (*P* = .04) were significantly higher in the patients who suffered severe COVID-19 illness when compared to the other groups. These findings have consolidated the similar evidence generated in other studies[16-18] where the researchers have found that hospitalized COVID-19 patients had higher prevalence of fatigue and exertional dyspnea when compared with non-hospitalized ones. In the patients with long-COVID, we found that the occurrence of hypoxia at rest (40%, *P* < .001), significant exertional desaturation on 6MWT (40%, *P* = .027), type 1 (20%, *P* = .001), and type 2 (20%, *P* = .001) respiratory failure was significantly more prevalent in patients with a history of severe COVID-19 compared to mild and moderate (Table 3). Similarly, a

Table 2. Clinical Presentation of Long-COVID Patients (n = 150)

	Overall (n = 150)	Mild (n = 118)	Moderate (n = 22)	Severe (n = 10)	
	n (%)	n (%)	n (%)	n (%)	*P**
i. Fatigue	108 (72)	77 (65.25)	21 (95.45)	10 (100)	.001
ii. Cough	100 (65.67)	70 (59.32)	22 (100)	8 (80)	.003
iii. Sputum	50 (33.34)	38 (32.20)	6 (27.27)	6 (60)	.233
iv. Breathlessness	106 (70.67)	76 (64.40)	20 (90.9)	10 (100)	.001
v. Wheezing	38 (25.34)	30 (25.42)	4 (18.18)	4 (40)	.660
vi. Chest pain	30 (20)	20 (16.95)	8 (36.36)	2 (20)	.219
vii. Fever	6 (4)	6 (5.08)	0 (0)	0 (0)	.338
viii. Hemoptysis	2 (1.34)	0 (0)	0 (0)	2 (20)	.004
ix. Loss of appetite	10 (6.67)	8 (6.78)	0 (0)	2 (20)	.572
x. Loss of weight	6 (4)	6 (5.08)	0 (0)	0 (0)	.338
xi. Tachycardia	26 (17.34)	14 (11.86)	8 (36.36)	4 (40)	.002
xii. Raised blood pressure (BP)	36 (24)	20 (16.95)	10 (45.45)	6 (60)	<.001
xiii. Tachypnea	6 (1.5)	0 (0)	2 (9.09)	4 (40)	<.001
xiv. Rhonchi on auscultation	26 (17.34)	20 (16.95)	2 (9.09)	4 (40)	.353
xv. Crepitations on auscultation	34 (22.67)	22 (18.64)	8 (36.36)	4 (40)	.04

**P* value represents the statistical significance between mild, moderate, and severe groups.

Table 3. Investigations of Long-COVID Patients (n = 150)

	Overall (n = 150)	Mild (n = 118)	Moderate (n = 22)	Severe (n = 10)	
	n (%)	n (%)	n (%)	n (%)	*P*
i. Ventricular ectopic in ECG	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
ii. Hypoxia at rest	6 (4)	0 (0)	2 (9.09)	4 (40)	<.001
iii. Desaturation in 6-minute walk test	22 (14.67)	14 (11.86)	4 (18.18)	4 (40)	.027
iv. Type 1 respiratory failure on ABG	4 (2.67)	0 (0)	2 (9.09)	2 (20)	.001
v. Type 2 respiratory failure on ABG	2 (1.34)	0 (0)	0 (0)	2 (20)	.004
vi. Anemia (Hb < 13.5 g/dL in males; Hb < 12.5 g/dL in females)	62 (41.34)	50 (42.37)	10 (45.45)	2 (20)	.337
vii. Leucocytopenia (TLC < 4000 cells/mm^3)	6 (4)	6 (5.08)	0 (0)	0 (0)	.338
viii. Leucocytosis (TLC > 10 000 cells/mm^3)	28 (18.67)	20 (16.95)	4 (18.18)	4 (40)	.147
ix. Neutropenia (n < 40%)	4 (2.67)	0 (0)	0 (0)	4 (40)	<.001
x. Neutrophillia (n > 80%)	4 (2.67)	2 (1.69)	0 (0)	2 (20)	.037
xi. Lymphopenia (L < 20%)	16 (10.67)	8 (6.78)	4 (18.18)	4 (40)	.002
xii. Lymphocytosis (L > 40%)	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
xiii. Thrombocytopenia (platelets <150 × 10^3/μL)	20 (13.34)	14 (11.86)	6 (27.27)	0 (0)	.9
xiv. Thrombocytosis (platelets >400 × 10^3/μL)	20 (13.34)	14 (11.86)	4 (18.18)	2 (20)	.409
xv. Deranged LFTs	54 (36)	42 (35.59)	8 (36.36)	4 (40)	.797
xvi. Increased blood sugars (RBS > 200 mg/dL or HbA1c > 5.7%)	20 (13.34)	12 (10.17)	6 (27.27)	2 (20)	.092

**P* value represents the statistical significance between mild, moderate, and severe groups.
ABG, arterial blood gases; ECG, electrocardiography; Hb, hemoglobin; LFT, liver function test; RBS, random blood sugar; TLC, total leucocyte count.

Table 4. Chest X-Ray Findings of Long-COVID Patients (n = 150)

	Overall (n = 150)	Mild (n = 118)	Moderate (n = 22)	Severe (n = 10)	
	n (%)	n (%)	n (%)	n (%)	*P*
i. Normal study	70 (46.67)	60 (50.84)	6 (27.27)	4 (40)	.114
ii. Diffuse reticulations	38 (25.34)	26 (22.03)	6 (27.27)	6 (60)	.017
iii. Lower zone reticulations	24 (16)	14 (11.86)	10 (45.45)	0 (0)	.248
iv. Diffuse nodular shadows	6 (4)	6 (5.08)	0 (0)	0 (0)	.338
v. Cystic changes	6 (4)	4 (3.39)	2 (9.09)	0 (0)	.9
vi. Mediastinal lymphadenopathy	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768
vii. Hyperinflated lung fields	8 (5.34)	8 (6.78)	0 (0)	0 (0)	.229
viii. Consolidation	2 (1.34)	2 (1.69)	0 (0)	0 (0)	.768

**P* value represents the statistical significance between mild, moderate, and severe groups.

Table 5. CT Scan Findings of Long-COVID Patients (n = 82)

	Overall (n = 82)	Mild (n = 60)	Moderate (n = 14)	Severe (n = 8)	
	n (%)	n (%)	n (%)	n (%)	*P*
i. Normal study	0 (0)	0 (0)	0 (0)	1 (0)	-
ii. Diffuse nodular shadows	26 (31.70)	22 (36.67)	2 (14.28)	2 (25)	.217
iii. Diffuse reticulations	32 (39.02)	22 (36.67)	8 (57.14)	1 (25)	.9
iv. Lower lobe reticulations	4 (4.87)	2 (3.34)	0 (0)	2 (25)	.07
v. Diffuse GGOs	36 (43.90)	24 (40)	10 (71.42)	2 (25)	.867
vi. Lower lobe GGOs	12 (14.63)	8 (13.34)	2 (14.28)	2 (25)	.478
vii. Honeycomb change	6 (7.31)	2 (3.34)	2 (14.28)	2 (25)	.027
viii. Bronchiectasis	12 (14.63)	8 (13.34)	2 (14.28)	2 (25)	.478
ix. Fibrocavitary changes	6 (7.31)	4 (6.67)	0 (0)	2 (25)	.339
x. Emphysematous changes	8 (9.75)	8 (13.34)	0 (0)	0 (0)	.154
xi. Mediastinal lymphadenopathy	2 (2.43)	2 (3.34)	0 (0)	0 (0)	.747
CT severity score					
i. Mild (<8)	50 (60.97)	44 (73.34)	2 (14.28)	4 (50)	.005
ii. Moderate (9-15)	12 (14.63)	8 (13.34)	4 (28.57)	1 (0)	.9
iii. Severe (>15)	20 (24.39)	8 (13.34)	8 (57.14)	4 (50)	.001

**P* value represents the statistical significance between mild, moderate, and severe groups.
CT scan, computed tomography scan; GGOs, ground-glass opacities.

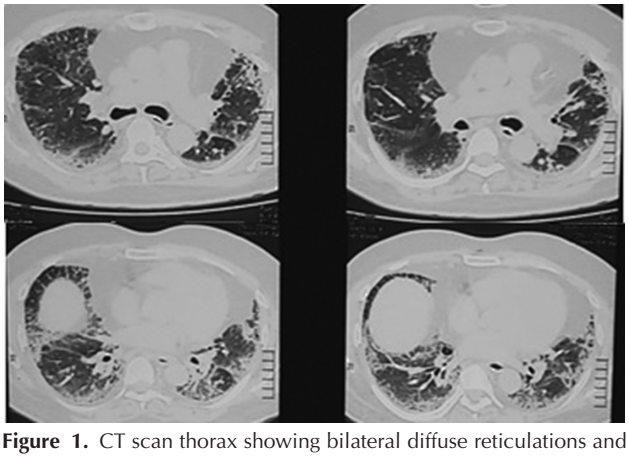

Figure 1. CT scan thorax showing bilateral diffuse reticulations and early honeycomb change in a patient with long-COVID. CT, computed tomography.

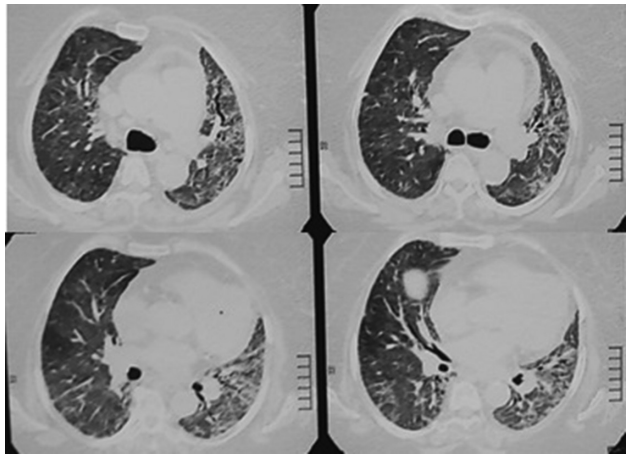

Figure 2. CT scan thorax from a patient with long-COVID showing persistent abnormalities in the form of reticulations and ground glass opacities. CT, computed tomography.

previous study[18] has also concluded that patients with severe COVID-19 have significant exertional desaturation in 6MWT and hypoxemia at follow-up when compared to patients with mild COVID-19 disease. Likewise, Townsend et al[19] found that the 6MWT distance reduced with the increased length of hospital stay during COVID-19. However, contrary to our findings, they concluded that persistent respiratory symptoms at the time of post-COVID assessment were not related to the initial severity of COVID-19.

In the current study, we found that nearly 53% of patients (n = 80) had abnormal chest radiographs at the time of presentation (Table 4). Reticulations in the lower zone (n = 24; 16%) and diffuse reticulations (n = 38; 25.34%) were the most common abnormalities. Another study[5] had documented the presence of bilateral reticulations (25.71%) as the most common abnormality in post-COVID-19 patients. We also found that diffuse reticulations were significantly more persistent in severe category patients (60%, *P* = .017) when compared with the mild and moderate ones indicating delayed recovery in the severe COVID-19 patients. In a study by Alarcón-Rodríguez et al.[20] it was found that patients with mild or moderate COVID-19 pneumonia tend to achieve complete radiological resolution within 1 month of follow-up. Also, they observed that patients with a history of severe disease and prolonged "intensive care unit" stay showed slow resolution. Similarly, Arnold et al[21] found that some patients with a history of admission due to oxygen requirement at the time of acute COVID-19 infection tend to show slow fibrotic lung changes in CT scan of the chest. These findings again were similar to our study.

Chest CT scan plays a vital role in diagnosis, searching for complications and prognostication of COVID-19 disease and it is the radiological investigation of choice for assessing the extent of lung parenchyma involvement at the time of acute infection as well as during follow-up.[22] In the present study, the most common abnormalities detected on CT scan of the chest (Table 5) was diffuse ground-glass opacities (n = 36; 43.90%) followed by diffuse reticulations (n = 32; 39.02%) and diffuse nodular shadows (n = 26; 31.7%). The current study has consolidated the evidence generated by other studies[5,23] where ground-glass opacities and diffuse reticulations were the commonest CT scan findings in long-COVID patients. On analysis of the CT scan of the thorax, except for the honeycomb change, the abnormal findings were not significantly different in the 3 groups of long-COVID patients. However, the honeycomb change was significantly more prevalent in patients with a history of severe COVID-19 (25%, *P* = .027) compared to patients with mild or moderate COVID-19. This finding may be indicative of the resolution of other CT scan abnormalities in due course of time, with permanent damage to the lung parenchyma evident in the form of honeycomb change, being the remaining persisting finding. The current study added to the evidence generated by another study[24] where more than one-third of the severe patients, at follow-up, had remnant fibrotic changes, defined in the study as traction bronchiectasis, parenchymal bands, or honeycombing, while mild or moderate category patients had either complete radiographic clearing or residual ground glass opacities or interstitial thickening.

We also used CTSS for the evaluation of CT scans of long-COVID patients in conjunction with another study[24] on post-COVID patients. We found that most of the long-COVID patients with a history of mild COVID-19 illness (73.34%) had mild CTSS (Table 5) and patients with severe COVID-19 infection history had severe CTSS (50%). Although a significant interpretation of this observation could not be reached.

Our study had certain limitations. First, the study was conducted in a referral tertiary care institute, and hence, the observations suffer from selection bias. Further, the patients with severe COVID-19 were in smaller numbers, which may have confounded the observations.

CONCLUSION

Our study reiterated the occurrence of pulmonary abnormalities in long-COVID patients. We observed that long-COVID pulmonary manifestations are, both clinically and radiologically, more severe as well as prolonged in severe COVID-19 patients. Hence, we can conclude that the pulmonary course of long COVID bears a relationship to initial disease severity. Therefore, a planned approach for more meticulous follow-up and management of COVID-19 patients should be advocated.

Ethics Committee Approval: Ethical committee approval was received from the Institutional Human Ethics Committee of Vallabhbhai Patel Chest Institute, University of Delhi (approval Number: VPCI/DIR/IHEC/2020/1847).

Informed Consent: Written informed consent was obtained from all participants who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

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