

To Study Clinical and Radiological Changes in Post COVID-19 Patients and its Impact on Quality of Life

Mohd Arif Husain¹, Gajendra Vikram Singh², Santosh Kumar³, Prashant Gupta⁴, Sachin Kumar Gupta⁵

¹Junior Resident, Department of TB & Respiratory Diseases S. N. Medical College Agra (U. P.) India

²Professor and Head, Department of TB & Respiratory Diseases S. N. Medical College Agra (U. P.) India

³Professor, Department of TB & Respiratory Diseases S. N. Medical College Agra (U. P.) India

⁴Principal and Dean, S N Medical College, Agra and ³Professor, Department of Surgery, S. N. Medical College Agra (U. P.) India

⁵Assistant Professor, Department of TB & Respiratory Diseases S. N. Medical College Agra (U. P.) India
Corresponding Author Email: [arifhusain2012\[at\]gmail.com](mailto:arifhusain2012[at]gmail.com)

Abstract: Background: The emergence of severe acute respiratory syndrome coronavirus (SARS-CoV), at the beginning of the 21st century, signaled a warning of cross-species transmissions that had the potential to rapidly spread across the globe. On March 11, 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) to be a pandemic, with approximately 20% of patients infected requiring hospitalization and 6% in critical care and needing invasive ventilatory assistance. Considering that the COVID-19 pandemic being the largest after world war II, it is important to investigate its effects on the long-term pulmonary capacity and functionality with the follow-up of patients who had the infection and to assess the morbidity associated with this disease. The aim of this study is to search the long-term effects of COVID-19 on patients who have had severe COVID-19 pneumonia history. We would like to find out the potential long-term impacts of COVID-19 on pulmonary capacity and health-related quality of life. **Methods:** Our study was a hospital based, observational and prospective study, which had been conducted on patients' admitted at Covid isolation facility and those patients attended O. P. D. of department of tuberculosis and respiratory diseases and department of medicine, S. N. Medical College Agra. **Results:** Out of 86 patients, at base line (At the time of discharge of the COVID patients) commonest symptom was fatigue 64%, followed by dyspnea 64%, cough 74%, and Chest Pain 42% and Fever 36% and Psychiatric Illness 32%. After 3 months of follow-up commonest symptom was fatigue 78%, followed by dyspnea 52%, cough 68%, Chest Pain 32%, Fever 12% and Psychiatric Illness 38%. • Out of 86 patients, Commonest radiological finding noted at baseline 48% have normal CXR finding followed by diffuse reticulation in 28%, Consolidation 28% and GGO 25%. After 3 months of follow-up on Chest X-Ray baseline 65% patients have normal CXR followed by diffuse reticulation in 32%, Consolidation 28% and GGO 25%. Out of 86 patients initially chest HRCT shows Reticulations 42% followed by GGO in 35%, Consolidation in 44%, Honey Combing 20% and Fibrosis 35%. After 3 months of follow-up commonest finding noted is Reticulations in 68% followed by GGO 28%, Consolidation 42%, Honey Combing 24% and Fibrosis 49%. **Conclusions:** Three months after recovering from COVID-19 pneumonia, significant clinical, radiological abnormalities and pulmonary function test impairment were found. Most of the patients reported a poor perceived health due to respiratory symptoms and every patient presented an overall deterioration of quality of life.

Keywords: COVID-19, SARS, HRCT.

1. Introduction

The emergence of severe acute respiratory syndrome coronavirus (SARS-CoV), at the beginning of the 21st century, signaled a warning of cross-species transmissions that had the potential to rapidly spread across the globe. After SARS, several other respiratory viruses- influenza A strains of avian flu H5N1, H1N1, and H7N9 and the Middle East respiratory syndrome coronavirus (MERS-CoV)- spilled over from animal populations into humans. Earlier, the zoonotic transmission of viruses, particularly coronaviruses that existed within bat populations, was identified as a significant public health threat given the habitat loss, climate change, globalization, and the uneven public health structure.

Therefore, it should not be a big surprise when a third human coronavirus (CoV) causing COVID-19 emerged in December 2019. Although the virus emerged in China, and spread rapidly around the world its health and economic

consequences were far more complex. The emergence of COVID-19 would turn into the greatest challenge facing global leaders since World War II.

On March 11, 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) to be a pandemic, with approximately 20% of patients infected requiring hospitalization and 6% in critical care and needing invasive ventilatory assistance. Early epidemiological reports showed that 8.2% of total cases presented with rapid and progressive respiratory failure, similar to acute respiratory distress syndrome (ARDS).

COVID-19 is characterized in the majority of cases by a mild respiratory disease, while in approximately 15% of cases a severe pneumonia is observed. The latter can progress to bilateral multifocal pneumonia, leading in 5% of total cases to ARDS, sepsis and septic shock¹.

Imaging Presentation and Follow-Up of COVID-19 Pneumonia

Imaging assessment of COVID-19 pneumonia had been performed with different modalities, including ultrasound (US), chest radiographs (CXR), and computed tomography (CT). The choice of imaging technique depends on equipment availability and clinical context, as well as national/regional needs and recommendations^{2, 3}. CXR and CT were currently used in patients with suspected or confirmed COVID-19 pneumonia³. Baseline CXR and chest CT had a sensitivity of 69% and 97% for the diagnosis of COVID-19, respectively⁴⁻⁶. CT may allow detecting COVID-19 pneumonia even before real-time PCR^{5, 6}. However, the huge drawback of CT was its low specificity (i. e., 25-56%) for COVID-19 pneumonia^{5, 6}, due to overlapping of imaging features with other viral or atypical pneumonia⁷⁻⁸.

Recent evidence suggests that the lungs are the organ most affected by COVID-19⁹ with different pathophysiological events that include diffuse alveolar epithelium destruction, hyaline membrane formation, capillary damage and bleeding, alveolar septal fibrous proliferation, and pulmonary consolidation¹⁰. A characteristic of COVID-19 is the extensive injury to alveolar epithelial cells and endothelial cells with secondary fibroproliferation¹¹, indicating a potential for chronic vascular and alveolar remodeling leading to lung fibrosis and/or pulmonary hypertension¹². These findings generate concerns regarding the assessment of lung injury for discharged patients¹⁰.

We had conducted this study to detect alterations in radiological findings and pulmonary function for the diagnosis and follow-up of patients with respiratory and functional sequelae produced by COVID-19, to determine the prevalence of restrictive pattern, obstructive pattern and altered diffusion in patients post-COVID-19 infection and to describe the different evaluations of respiratory function used with these patients and to asses quality of life of patient after COVID 19.

Aim

To study Clinical and Radiological features among post COVID-19 patients and its impact on quality of life.

Objectives

- 1) Prevalence of different symptoms during follow-up,
- 2) Pattern of spirometric changes by pulmonary function test.
- 3) Prevalence of radiological findings by chest x ray and CT scan.
- 4) Assessment of quality of life in post COVID-19 patients.

2. Material & Methods

Study Population: Diagnosed cases of COVID-19 by TRUNAAT or RTPCR admitted in COVID ISOLATION FACILITY and those patients attending out-patient department of tuberculosis and respiratory diseases and department of medicine.

Study duration: The study was carried in January, 2021 to

June, 2022.

Study Design: The study was prospective observational study.

Sample Size: Patients satisfying the inclusion and exclusion criteria reached 86.

Inclusion Criteria:

- 1) Is willing and able to give informed consent to be enrolled in the research project and for follow-up.
- 2) Confirmed case (by TRUNAAT/RTPCR) of post COVID 19 patient either Asymptomatic or symptomatic.
- 3) Patients attending out-patient department of tuberculosis and respiratory diseases and department of medicine.

Exclusion Criteria:

- 1) Those who are not willing to be a part of our study or not given consent in written.
- 2) Patient having any prior lung pathology like interstitial lung diseases, *tuberculosis*, COPD or Asthma, lung cancer or cardiovascular pathology.

3. Observations and Results

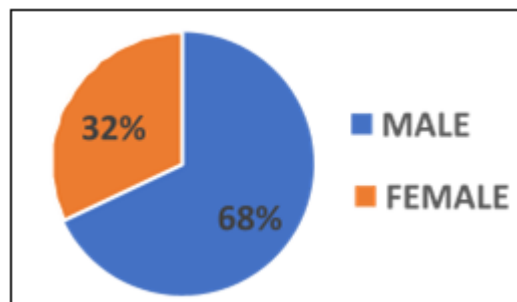


Figure 1: Distribution of the study population according to gender

Table 1: Distribution of the study population according to the age (n=86)

	Males		Female		Total	
	No	%	No	%	No	%
< 18	13	55.46	10	44.54	23	26.32
19-44	18	62.20	11	37.80	29	33.44
45-60	14	58.66	10	41.34	24	28.62
>60	6	64.42	4	35.58	10	11.62

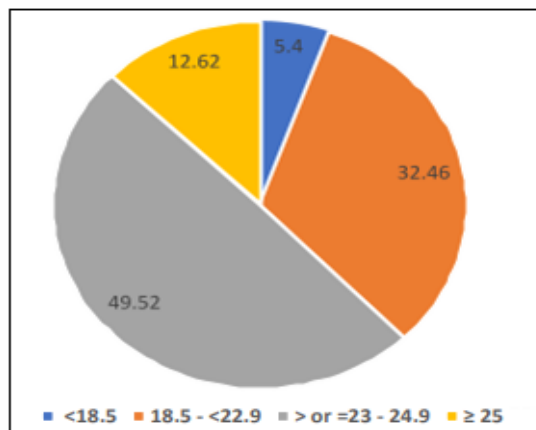


Figure 2: Distribution of the study population according to the BMI (n=86)

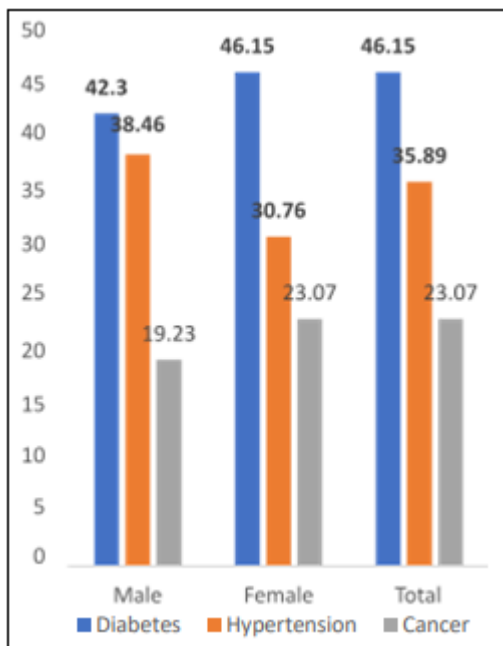


Figure 3: Distribution of the study population as per the comorbidities (n=39)

Table 2: Changes in clinical symptoms during follow up (n=86)

Clinical symptoms	Category	Base line (At the time of discharge)		After three months of discharge		P value
		NO	%	NO	%	
Dyspnea	+	55	64	45	52	0.023
	-	31	36	41	58	
Fatigue	+	70	82	67	78	0.042
	-	16	18	19	22	
Fever	+	30	36	10	12	0.07
	-	56	64	76	88	
Cough	+	63	74	58	68	0.01
	-	23	26	28	32	
Chest pain	+	36	42	27	32	0.04
	-	50	58	59	68	
Psychiatric illness	+	27	32	32	38	0.03
	-	59	78	54	62	

Table 3: Distribution of the study population as per the Grades of breathlessness (Dyspnea) (n=86)

PFT Patterns	Base line (At the time of discharge)		After three months of discharge	
	No	%	No	%
Normal	21	24	38	45
Obstructive	10	12	7	9
Restrictive	41	48	28	32
Mixed	14	16	13	14
	86	100	86	100

Table 4: Radiological features changes during follow up (HRCT Scans) (n=86)

mMRC GRADE	Base line (At the time of discharge)		After three months of discharge	
	No.	%	No.	%
0	22	25.58 %	34	39.53 %
I	34	39.53 %	21	24.41 %
II	15	17.44%	24	27.90 %
III	9	10.46%	5	5.81 %
IV	6	6.97 %	2	2.32 %

Table 5: Patterns of Spirometric Changes by PFT

HRCT Changes	Category	Base line (At the time of discharge)		After three months of discharge		P value (chi-square)
		NO	%	NO	%	
Reticulation	+	36	42	58	68	.046
	-	50	58	28	32	
GGO	+	30	35	24	28	.0021
	-	56	65	62	72	
Consolidation	+	37	44	36	42	.084
	-	49	56	50	58	
Honey combing	+	22	18	18	20	.004
	-	64	82	68	80	
Fibrosis	+	30	35	42	49	.001
	-	56	65	44	51	

Table 6: Assessment of Quality of Life by St. George’s Respiratory Questionnaire

	Base line (At the time of discharge)		After three months of discharge		P value (paired t-test.)
	Mean	SD	Mean	SD	
Symptoms Score (0-100)	49.71	20.76	33.79	18.0	.002
Activity Score (0-100)	51.68	22.9	42.48	21.4	.014
Impact Score (0-100)	40.88	26.46	22.44	20.4	.043
Total Score (0-100)	47.42	21.4	32.90	18.6	.034

Table 7: Changes in Various parameters in 6-min walk test.

Characteristics	Base Line (At the time of discharge)				After three months of discharge				P Value
	Prior 6 MWT		Post 6 MWT		Prior 6 MWT		Post 6 MWT		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
SPO ₂	90	1.29	88.5	1.33	97	1.79	95.45	2.58	.0012
Systolic BP	114.4	12.4	117.5	12.6	113.5	13.6	13.6	13.56	.0234
Diastolic BP	78.15	6.24	80.33	6.36	80.95	6.54	6.54	6.64	.456
Pulse Rate	94	13.12	98.2	12.76	84	12.60	12.60	12.76	.003
Distance Walked (mean)	420 mts (SD-117)				490 mts (SD-141)				17%
BORG Scale (6-20)	Mean 14.3		SD 2.4		Mean 16.6		SD 2.6		.004

P-value for comparison between two groups were calculated using paired t-test. Lower BORG Score denotes lower level of exertion and associated dyspnea

4. Discussion

The number of recovered cases of COVID-19 were increasing, there had also been a rise in number of patients with persistent symptoms even after turning negative for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

In a study it was found that almost 87.4% post COVID-19 patients, reported persistence of at least 1 symptom, most common symptoms being fatigue and dyspnea. Another study found that almost 71% had radiologic abnormalities and about 25% had lung function abnormalities even after 3 months of discharge following COVID-19. (13)

We evaluated the clinical and radiologic changes in post-COVID-19 patients 3 months after discharge from hospital or home isolation and RTPCR become negative for COVID-19 present to department of TB and Respiratory disease and department of Medicine of SNMC Agra.

Among the study population of 86 patients median age was 42 years (19-44 years). (Table 1) 68% (58) were males and

32% (28) were females. In another study done by *Xiaojun Wu et. al* of 47 (57%) patients were males and 36 (43%) were females out of 135 patients. The median age was 60 years.

The average BMI was 24.5 kg/m² (figure-2). In study by *Xiaojun Wu et. al* the median BMI was 25.1 kg/m² in male and 24.3 kg/m² in female. In the above studies there was a relationship between BMI and COVID- 19 pt. which is significant which was accordance to our study. (14)

Most common co-morbidity was diabetes followed by hypertension (Figure-3). 38.46% males and 46.15% females were hypertensive and 42.30% males and 30.76% females were diabetic. In another study done *Nitin Goel et. al* 23% patient had hypertension followed by diabetes mellitus (17%) was the most common non-respiratory comorbidity. Patient having these comorbidities suffered more severe COVID – 19 requiring acute hospital care and require more aggressive medical care. (15)

At base line most common symptom groups were fatigue 70 (64%), followed by dyspnea 55 (64%), cough 63 (74%), and

Chest Pain 36 (42%) and Fever 30 (36%) and Psychiatric Illness 27 (32%) (Table- 2). After 3 months of follow-up common symptoms were fatigue 67 (78%), followed by dyspnea 45 (52%), cough 58 (68%), Chest Pain 27 (32%), Fever 10 (12%) and Psychiatric Illness 32 (38%). In another study *Nitin Goel et. al* The most common symptom in the present post-COVID- 19 patient population was fatigue (65%) followed by breathlessness (60%) and cough (45%).

At baseline Grade 0 Dyspnea present in 22 (18.92 %), in Grade I present in 34 (29.24 %), Grade II present in 15 (12.90 %), in Grade III present in 9 (7.74 %) and in Grade IV present in 06 (5.16 %) (Table- 3). After 3 months of discharge Grade 0 Dyspnea present in 34 (29.24 %), in Grade I present in 21 (18.06 %), Grade II present in 24 (20.64 %), in Grade III present in 5 (4.30 %) and in Grade IV present in 2 (1.72 %). So, in our study most of the patients have Grade I Dyspnea initially and after follow-up of 3 months most of the patients had Grade II Dyspnea. When patient were stratified by mMRC level at hospital discharge and after 3 months, the number of patient at mMRC levels I, III and IV during follow-up and number of patients increased at mMRC level II during follow-up. So, the mean mMRC score decreased during follow-up, this showed a reduction in the impact of Dyspnea on daily activities. In another study done by Xiaojun Wu *et. al* Dyspnea symptoms assessed using the mMRC scale were very frequent in patients at 3 months, with 67 (81%) patients with an mMRC score of at least 1 and five (6%) patients with an mMRC score of least 2. Our study compares with above study and showed that reduction in the impact of Dyspnea on daily activities. (17)

With respect to HRCT findings, 5 patients had central lesion and 16 patient had peripheral lesion and 65 had both on axial plain of HRCT scans. Initially chest HRCT showed Reticulation 36 (42 %), GGO 30 (35%), Consolidation 37 (44 %), Honey Combing 22 (18 %) and Fibrosis 30 (35 %) (Table-4). After 3 months of follow-up most common findings Reticulation 58 (68 %), GGO 24 (28%), Consolidation 36 (42 %), Honey Combing 18 (20 %) and Fibrosis 42 (49 %). In another study *Ying Xiong et. Al* most of the single GGO progressed to multiple ground glass infiltration in the lungs. More cases with consolidation (34/42, 81%), interstitial thickening or reticulation (29/42, 69%), air bronchograms (26/42, 62%), pleural effusion (16/42, 38%), and fibrous strips (31/42, 74%) could be seen (all $P \leq 0.01$). The diffuse lesions in bilateral lungs could be seen in the most seriously affected patients, whose CT showed as “white lungs”. In another study *Nitin Goel et. al* diffuse reticulations (53%) was commonest observation followed by diffuse ground glass opacities (GGOs) (35%) and diffuse nodular shadows (29%).

Most of the patients showed restrictive pattern 41 (48 %) out of 86 during the follow-up No. of patients of Restrictive pattern decreased, this reflect improvement of patient during follow-up. In COVID-19 patients after 3 months of discharge, residual abnormalities of pulmonary function was observed with most common finding being reduction in DLCO (Table-5). Low DLCO could be consequence of interstitial abnormalities or pulmonary vasculature abnormalities caused by COVID-19. (16)

We used St. George's respiratory questionnaire to asses' quality of life of healed cases of pulmonary tuberculosis. The St. George's Respiratory Questionnaire (SGRQ) is a well validated respiratory disease specific HRQoL measure yielding scores related to symptoms (concerning the frequency and severity of respiratory symptoms), activity (the degree to which activities are limited by breathlessness), and impact (aspects of social and psychological function affected by respiratory disease). In addition, a total score summarizes disease impact on overall health status. We calculated Mean score for symptoms, activity, impact and total score of SGRQ and correlated with HRCT findings of post COVID-19 patients and interpretation were as followed-Initially after discharge, SGRQ Total mean score was 47.42 and Symptoms, Activity and Impact mean score were 49.71, 51.68 and 40.88 and after follow up of 3months Total mean score was 32.90 and Symptoms, Activity and Impact score were 33.79, 42.48 and 22.44 (Table-6). Lower SGRQ Score denote better quality of life. The latter score show that patient still had an impaired HRQoL relative to a general population-based norm. Even after three months of discharge these patients were found to suffer from psychologic disturbances like depression, anxiety and post-traumatic stress disorder along with poor quality of life.

As SGRQ score increases, quality of life deteriorate. After three months of discharge, patients had low SGRQ score and improved quality of life from baseline.

High grade of Borg's scale of dyspnea had also been noted in the study population. Lower score denotes lower level of exertion and associated dyspnea.

Low mean Spo2 from the baseline as well as at the end of 6MWD had been noted and less decrease in mean Spo2 at the end of 6MWT as compared from mean of baseline Spo2 (Table-7).6MWD increase from the base line indicates improvement of quality of life of the patients. After three months of discharge exercise tolerance also increased as measured by 6MWD.

5. Conclusion

Result of this study confirms that HRCT is an utmost important imaging modality in the diagnosis and management of post COVID- 19 patients. Three months after recovering from COVID- 19 pneumonia, significant clinical, radiological abnormalities and pulmonary function test impairment were found. Most of the patients reported a poor perceived health due to respiratory symptoms and every patient presented an overall deterioration of quality of life. Our findings highlighted the importance of respiratory follow-up of patients with COVID- 19 and to mitigate the long term consequences of COVID-19 pneumonia, including pulmonary rehabilitation as well as novel therapeutics.

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