

Pulmonary Function Assessment in Patients after Covid 19 Pneumonia

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Abstract

Background : COVID-19 pneumonia may result in clinically relevant alterations in pulmonary function tests.

Aim : Aim of the study is to evaluate pulmonary function in post COVID 19 patients.

Materials and Method : Study was conducted at Al Azhar Medical college in 25 patients confirmed by RT-PCR between the period of August 2020 to January 2021

Result : After 2 weeks of antigen negativity, FEV1, FVC, FEV1/FVC ratio were measured using spirometer and TLC and DLCO were assessed with DLCO machine and these tests were repeated after 6 weeks during a follow up study.

Conclusion: This study findings suggest that COVID 19 pneumonia can result in altered Lung volumes and capacities, with mainly a restrictive pattern and reduced Diffusion capacity.

Keywords: COVID 19, Pulmonary function test, FEV1, FEV1/FVC, DLCO, TLC.

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I. Introduction

On 11 March 2020, the World Health Organization (WHO) declared corona virus disease 2019 (COVID-19) as a pandemic. As of 9th August, more than 19.7 million cases have been confirmed worldwide including more than 7 lakhs of mortality. [1]. Persistent impairment of pulmonary function and exercise capacity have been known to last for months or even years [2–5] in the recovered survivors from other corona virus pneumonia (severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS)). This article aims to describe the characteristics of pulmonary function in these subjects.

We recruited laboratory-confirmed noncritical COVID-19 cases, from 1st August 2020 to 15th January 2021. According to the Treatment guidelines of August 2020. Department of Health & Family Welfare Govt of Kerala. Disease severity was categorized clinically as mild illness (No breathlessness or Hypoxia) Moderate (dyspnea and/ or hypoxia, fever, cough, SpO₂ ≤ 94% on room air, Respiratory Rate ≥ 24 per minute) and severe (Pneumonia plus one of the following respiratory rate ≥ 30 breaths/min, severe respiratory distress, SpO₂ ≤ 90% on room air) [6]. Critical cases were excluded from our study. Spirometry test and DLCO was performed following the American Thoracic Society/European Respiratory Society guidelines after 2 weeks and 6 weeks of antigen negativity. Written informed consent was obtained from all patients

This is a follow up study of COVID-19 patients diagnosed by positive polymerase chain reaction (PCR) testing on nasopharyngeal swab of patients. The study was conducted in 25 patients who visited post covid lung clinic at Pulmonology department Al Azhar medical college, after two weeks of antigen negativity. Total of 25 patients, 14 males and 11 females were selected for study. Critically ill patients and Patients less than twenty years of age were excluded from this study. Patient history, body mass index (BMI), smoking habit, preexisting co morbidities were collected. Spirometry and DLCO was done in all patients included in this study.

Pulmonary function tests were performed using portable spirometer. Forced expiratory volume in the first second (FEV₁), forced vital capacity (FVC) and FEV₁/FVC ratio were included in the analysis. For each patient values for FEV₁, FVC, FEV₁/FVC, TLC and DLCO were also calculated by Global Lung Function 2012 equations [7]. Pulmonary function tests and Diffusion capacity tests were done 2 weeks and 6 weeks of antigen negativity.

II. Material And Methods

This prospective observational study was carried out on patients of Department of Pulmonary Medicine at AL Azhar Medical College and Superspeciality Hospital , Kerala from 1st August 2020 to 15th January 2021. A total 25 patients were included in this study.

Study Design: Prospective observational study

Study Location: Department of Pulmonary Medicine at AL Azhar Medical College and Superspeciality Hospital , Kerala

Study Duration: From 1st August 2020 to 15th January 2021

Sample size: 25 patients.

Inclusion criteria:

1. Age \geq 20 years
2. Post covid 19 patients after 2 weeks of antigen negativity
3. Patients with smoking history

Exclusion criteria:

1. Age < 20 years
2. Critically ill patients

Procedure methodology

Post covid patients after two weeks of antigen negativity were selected for the study. Patient's history, Age, Gender, body mass index (BMI), smoking habit, preexisting co morbidities were collected. Spirometry and DLCO was done in all patients included in this study.

Pulmonary function tests were performed using portable spirometer . Forced expiratory volume in the first second (FEV1), forced vital capacity (FVC) and FEV1/FVC ratio were included in the analysis. For each patient values for FEV1, FVC, FEV1/FVC, TLC and DLCO were also calculated. Pulmonary function tests and Diffusion capacity tests were done 2 weeks and 6 weeks of antigen negativity.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics Software (version 24; IBM, New York, USA). The comparisons of counting data were evaluated using the Chi-square test. A p-value of less than 0.05 was defined as statistically significant.

III. Results

In our study we evaluated 25 Patients who recovered from COVID 19, which included 15 Males and 10 Female patients and 48 % patients were in age group of 20-40 years. Most of the patients had Fever, dry cough and breathlessness as predominant symptoms at the time of presentation. Out of 25 patients 8 were Smokers, 4 patients had BMI more than 30Kg/m² (Obese). In this study 13 patients (52%) had at least one underlying co morbidity, of which 44% had hypertension and 24% had diabetes 8% patients had CVA and 20 % had CAD.

Table 1 Demographic parameters of COVID-19 patients studied

Patients	Age	Sex	BMI	DM	HTN	CVA	CAD	SMOKING
1	41	M	28.2	N	Y	N	N	Y
2	36	M	26.4	N	N	N	N	N
3	29	F	23.7	N	N	N	N	N
4	68	M	31.2	Y	Y	N	Y	Y
5	55	F	22.6	Y	N	N	N	N
6	32	F	28.2	N	N	N	N	N
7	56	M	26.8	N	Y	N	Y	Y
8	40	F	30.7	N	N	N	N	N
9	36	M	23.0	N	N	N	N	N
10	31	M	27.5	N	N	N	N	N
11	67	M	20.3	Y	Y	N	N	Y
12	35	M	24.6	N	N	N	N	N
13	22	F	26.2	N	N	N	N	N
14	69	M	25.8	Y	Y	N	Y	Y
15	33	F	22.1	N	N	N	N	N
16	37	F	28.9	N	Y	N	N	N
17	64	M	30.6	N	Y	Y	N	Y
18	60	F	23.6	N	Y	N	N	N
19	54	M	29.7	Y	Y	N	N	Y
20	29	M	32.3	N	N	N	N	N
21	27	F	23.6	N	N	N	N	N

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22	28	M	26.7	N	N	N	N	N
23	68	M	29.2	Y	Y	Y	N	N
24	55	F	22.4	N	Y	N	Y	N
25	48	M	20.8	N	N	N	Y	Y

In this study out of 25 patients, 11(44%) patients had restrictive pattern ,5 patients(20%) had obstructive pattern and 9 patients had normal pulmonary function tests after 2 weeks of antigen negativity. DLCO performed in these patients showed impaired Diffusion capacity in 14(56%) patients. A reduced Total lung capacity was noted in 12 (48%) patients.

Follow up study after 6 weeks, showed an overall improvement in pulmonary function but pattern of pulmonary functions (obstruction /restriction) remained the same. Follow up DLCO at 6th week showed an improvement in 16% of patients.

Table 2 Pulmonary function parameters of COVID-19 patients studied

patient	2 weeks					6 weeks				
	FVC	FEV1	FEV1/FVC%	TLC	DLCO%	FVC	FEV1	FEV1/FVC	TLC	DLCO
1	1.8	1.25	69.4	4.8	75	1.86	1.3	69.9	4.9	74
2	1.3	1.4	93	3.8	76	1.2	1.3	92	3.7	74
3	2.5	2.2	88	5.3	98	2.6	2.4	92	5.2	106
4	2.4	1.5	62.5	4.2	78	2.5	1.7	68	4.3	80
5	2.0	1.7	85	4.8	110	1.9	1.75	92	4.9	112
6	1.9	1.6	84.2	4.7	90	1.8	1.6	88	4.2	100
7	2.2	1.3	59.09	3.9	78	2.1	1.4	66.6	4	80
8	1.4	1.6	114.3	3.5	72	1.45	1.7	117.2	3.8	80
9	2.4	2.3	95	4.9	98	2.3	2.3	100	5	96
10.	2.1	2.2	104	3.8	76	2.2	2.3	95	4	78
11.	1.5	1.3	87	3.3	70	1.5	1.4	93	3.5	74
12.	2.6	2.4	92	4.8	94	2.5	2.4	96	4.9	98
13.	1.8	1.6	88	3.8	76	1.7	1.9	89	3.9	78
14.	1.5	1.4	93	3.9	78	1.8	1.7	94	4	82
15.	2.3	1.5	65	4.5	110	2.3	1.6	69.5	4.5	108
16.	2.2	1.8	81	3.8	76	2.1	1.8	85	3.9	80
17.	2.2	1.3	59	4.5	90	2.1	1.5	71	4.6	90
18.	2.3	1.8	78	4.0	88	2.1	1.8	81	4.3	90
19.	1.1	1.2	109	3.8	75	1.4	1.3	93	4	80
20.	1.9	1.6	84	4.8	110	1.8	1.6	88	4.7	108
21.	2.1	1.7	81	4.4	92	2.2	1.8	81	4.5	90
22.	1.6	1.4	88	3.5	76	1.7	1.5	88	3.6	76
23.	1.8	1.6	89	3.6	79	1.8	1.7	94	3.5	78
24.	1.5	1.3	87	3.8	72	1.5	1.4	93	3.9	79
25.	1.9	1.7	89	4.2	98	1.9	1.8	94	4.1	95

Figure1: Showing PFT pattern in the study group

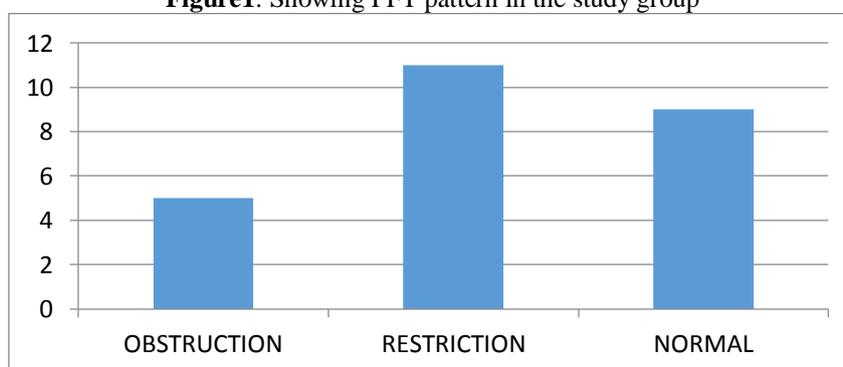


Table 3 : FEV1 Change at 6 weeks

	Improvement in FEV1	Worsening in FEV1	NO CHANGE IN FEV1
OBSTRUCTION	5	0	0
RESTRICTION	9	1	1
NORMAL	4	0	5

Table 4 : FEV1 Change at 6 weeks

PATTERN	IMPROVEMENT IN FEV1	WORSENING/ NO CHANGE IN FEV1
OBSTRUCTION	5	0

RESTRICTION	9	2
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Table 5 : FEV1 Change at 6 weeks

PATTERN	IMPROVEMENT IN FEV1	WORSENING & NO CHANGE IN FEV1	P VALUE
OBSTRUCTION&RESTRICTION	14	2	0.021
NORMAL	4	5	

Table5 : Showing improvement in FEV1 in obstruction & restriction pattern was statistically significant .

Table 6: FVC changes at 6th week .

PATTERN	IMPROVEMENT IN FVC	WORSENING IN FVC	NO CHANGE IN FVC
OBSTRUCTION	2	1	2
RESTRICTION	5	3	3
NORMAL	2	6	1

Table 7: FVC changes at 6th week.

PATTERN	IMPROVEMENT IN FVC	WORSENING& NO CHANGE IN FVC	P VALUE
OBSTRUCTION	2	3	0.838
RESTRICTION	5	6	

Table 8: FVC changes at 6th week

PATTERN	IMPROVEMENT IN FVC	WORSENING& NO CHANGE IN FVC	P VALUE
OBSTRUCTION&RESTRICTION	7	9	0.281
NORMAL	2	7	

As shown in Tables 7and 8, FVC changes at 6 weeks in obstruction & restriction group was not statistically significant compared to normal.

Table9: TLC changes at 6th week.

PATTERN	IMPROVEMENT IN TLC	WORSENING IN TLC	NO CHANGE IN TLC
OBSTRUCTION	4	0	1
RESTRICTION	9	2	0
NORMAL	5	4	0

Table 10: TLC changes at 6th week.

PATTERN	IMPROVEMENT IN TLC	WORSENING & NO CHANGE IN TLC	P VALUE
RESTRICTION	9	2	0.202
NORMAL	5	4	

Table 11: TLC changes at 6th week.

PATTERN	IMPROVEMENT IN TLC	WORSENING & NO CHANGE IN TLC	P VALUE
OBSTRUCTION&RESTRICTION	13	3	0.16
NORMAL	5	4	

As shown in Tables 10 and 11 TLC changes at 6 weeks was not statistically significant

Table 12: DLCO changes at 6 weeks

PATTERN	IMPROVEMENT IN DLCO	WORSENING IN DLCO	NO CHANGE IN DLCO
OBSTRUCTION	2	2	1
RESTRICTION	8	2	1
NORMAL	5	4	0

Table 13: DLCO changes at 6 weeks

PATTERN	IMPROVEMENT IN DLCO	WORSENING & NO CHANGE IN DLCO	P VALUE
OBSTRUCTION	2	3	0.21
RESTRICTION	8	3	

Table 14: DLCO changes at 6 weeks

PATTERN	IMPROVEMENT IN DLCO	WORSENING & NO CHANGE IN DLCO	P VALUE
OBSTRUCTION&RESTRICTION	10	6	0.733
NORMAL	5	4	

As shown in Tables 13 and 14 DLCO changes at 6 weeks was not statistically significant.

IV. Discussion

The present study suggest that COVID-19 pneumonia may result in clinically relevant alterations in pulmonary function tests, with a restrictive pattern in 11 and obstructive pattern in 5 out of 25 patients at second week of antigen negativity. After 6 weeks, pulmonary function improved, but some degree of restrictive alteration still persisted.

Recent studies reveal that the lung is the organ most affected by COVID-19 [8,9], with pathologies that include diffuse alveolar epithelium destruction, capillary damage, hyaline membrane formation, alveolar septal fibrous proliferation, and pulmonary consolidation. Previous studies have demonstrated that recovered patients with corona virus pneumonia can be left with damaged lungs. Impaired lung function was common and could last for months or even years. In our study, the greater decline in DLCO suggest that the diffusion membrane injury may be more causative of the pulmonary dysfunction compared to lowered lung volume. DLCO abnormalities occurred in more than half of the COVID-19 patients and the data indicated that impaired diffusion pathways is intra-alveolar. S.A. MEO et al. reported that severe acute respiratory syndrome (SARS) and COVID-19 had similar biological and clinical characteristics [10]. In addition to acute lung injury, neuromuscular weakness could also lead to decreased lung function. Obstructive pattern observed in our study may be due to associated Smoking habits or airway hyper responsiveness.

There are limitations in our study. First, the lack of baseline pulmonary function test results prior to the COVID 19 make it difficult to make a comparison with the results after the illness. Secondly, the association between CT images and the lung function parameters was not analyzed in our study. Finally, this study only provides a short follow-up, and the long-term evaluation of lung function after hospital discharge requires further investigation.

In conclusion, our study reveals that, in discharged survivors with COVID-19, impairment of diffusion capacity is the most common abnormality of lung function, followed by restrictive ventilatory defects. Pulmonary function tests, spirometry and also diffusion capacity should be considered in routine clinical follow-up for certain recovered survivors, especially in severe cases. Subsequent pulmonary rehabilitation might be considered as an optional strategy. Long-term studies are needed to address whether these deficits are persistent.

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