European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 10, Issue 03, 2023

Original Research Article

Evaluation of pulmonary function in post-COVID-19 patients and its relationship to the illness's severity: A prospective study

[1]Sindhoora Rawul, [2]Sailaja Reddy Thikkavarapu, [3]Punnam Pradeep Kumar, [4]Shahzad Hussain Arastu

[1]Assistant Professor, Department of Pulmonology, Shadan Institute of Medical Sciences, Hyderabad, Telangana, India
[2]Assistant Professor, Department of General Medicine, Shadan Institute of Medical Sciences, Hyderabad, Telangana, India
[3]Assistant Professor, Department of Pulmonology, Ayaan Institute of Medical Sciences, Hyderabad, Telangana, India
[4]Associate Professor, Department of Pulmonology, Shadan Institute of Medical Sciences, Hyderabad, Telangana, India

Corresponding Author:
Dr. Shahzad Hussain Arastu (shahzadhusainarastu@yahoo.com)

Abstract

Introduction: More than 15.9 million people in 200 countries have been impacted by the COVID-19 pandemic brought on by the extremely contagious SARS-CoV-2 virus. The highly contagious coronavirus spreads through droplets made by talking, sneezing, coughing, and even breathing. Another potential source of contamination is indirect contact with contaminated surfaces. PFT is a useful method for evaluating respiratory diseases. The most frequently used test is spirometry, which is the primary diagnostic method for airway illnesses such asthma and chronic obstructive pulmonary disease (COPD). Measurements of lung volumes, diffusing capacity, and exercise physiology tests balance out the other examinations. The purpose of this study was to examine how the lungs functioned following COVID infection.

Method: This one-year prospective study was conducted at a tertiary hospital which included 50 subjects. The subjects were assessed for 100-M walk test, FEV1, FVC and FEV1/FVC ratio post covid infection. The data was noted and analysed for association with severity.

Results: The study had predominantly males and the overall mean age was 52.68± 7.7 years. The severity was noted ranging from ground glass appearance, paving's, consolidations and opacities. The PFT parameters at the end of COVID infection were certainly reduced based on the severity.

Conclusion: We could conclude increased severity led to significant PFT changes hampering a person directly and vice-versa. Larger population- based studies are required to justify the study findings.

Keywords: COVID, Pulmonary function test (PFT) and disease severity

Introduction

The World Health Organization (WHO) proclaimed coronavirus disease 2019 (COVID-19) to be a pandemic on March 11, 2020. 20% of infected individuals needed hospitalisation and 6% were in severe condition and required invasive ventilatory support [1]. Early epidemiological report revealed that acute respiratory distress syndrome-like fast and worsening respiratory failure was found in 8.2% of all cases (ARDS) [2].

Although several other organs are also affected, the lung is the primary organ affected by COVID-19 infection. From simple symptoms like a fever, myalgia, and diarrhoea to severe

ISSN 2515-8260 Volume 10, Issue 03, 2023

dyspnea requiring oxygen therapy or ventilation assistance, the symptoms can range widely. Acute respiratory distress syndrome affects roughly 40% of patients, and 20% of those cases are severe [3].

The severe damage to alveolar epithelial and endothelial cells, along with subsequent fibro-proliferation, is a hallmark of COVID-19 and suggests a possibility for persistent vascular and alveolar remodelling that could result in lung fibrosis and/or pulmonary hypertension. These findings raise questions about how patients who have been discharged should be assessed for lung injury [4, 5]. The most often used objective functional respiratory evaluations are pulmonary function tests (PFTs), which include spirometry, diffusion capacity, and lung volumes [6].

We decided to conduct a prospective study to look into the pulmonary profile after the coronavirus infection and its relationship to disease severity because it is crucial to identify changes in pulmonary function for the diagnosis and follow-up of patients suffering from respiratory and functional sequelae caused by COVID-19. Hence the present study is aimed to investigate the pulmonary profile after the coronavirus infection and its relation to disease severity.

Material and Methods

Study Area: The study was conducted among patients attending department of general medicine/emergency medicine/pulmonology of a tertiary hospital.

Study Design: Prospective observational study.

Study Period: January 2022 to December 2022 (01 Year).

Ethical Approval: Institutional ethical committee approval was obtained prior to the initiation of the study.

Study Population: Subjects who presented with cold, cough, fever, SOB and who were diagnosed with COVID- 19 to the department of general medicine/ emergency medicine at a tertiary hospital.

Inclusion criteria

1) Both the sexes and above the age of 18 years.
2) Lab confirmed covid-19 subjects.
3) Consented subjects.

Exclusion criteria

1) Subjects below 18 years.
2) Pregnancy.
3) Viral infections such as HIV and HBV.
4) Unwilling and non-consented subjects.

Sample Size: The prevalence of COVID-19 in India is 11% in a study by Niraj N *et al.* [7] using this as basis the present study sample size can be estimated using the formula.

$N = 1.96*1.96*pq/L^2$ (absolute precision)

P: Prevalence.

Q: 1-prevalence.

L: Allowable error.

- p= 11% = 0.11
- q= 0.89 (1-p)
- L=10% = 0.1

N = 1.96*1.96* 0.01*0.99/0.1*0.1
= 0.3760/ 0.01
= 38

ISSN 2515-8260 Volume 10, Issue 03, 2023

The minimum sample size required for the study is 38. As the study progressed a total of 50 were included.

Study Tools: Pre-designed pre-tested questionnaire.

Data collection methodology: The subjects were included in the study after their consent sociodemographic details were noted. History will be taken from patients and attenders. Important history regarding sudden onset of COVID-19 symptoms and any associated history was noted. Detailed past medical history that includes the presence or absence of diabetes and hypertension, duration of diabetes and hypertension and other known clinical illness like RHD, CAD, CKD, DCLD, Pulmonary Tuberculosis, Bronchial Asthma, COPD etc. Personal history related to addictive habits, sleep, diet, alcohol, smoking and narcotics will also be taken. Examination will be done according to proforma. All patients were subjected to complete physical examination, systemic examination and anthropometry. After discharge the patients were followed up and PFT were performed and noted. Data about the COVID- 19 hospitalization and the details of treatment. Data about post- COVID- 19 manifestations primarily pulmonary including emerging and persisting symptoms. All the routine investigation including the complete blood counts, PFT, ESR, routine urine examination, renal function test, liver function test, serum electrolytes, blood sugars, urine and blood culture and sensitivity, ECG, 2D ECHO, chest X-ray, USG abdomen was done. A few extra investigations were done in indicated subjects mainly, sputum examination, RT-PCR, USG abdomen, psychiatric review, CT of lungs and lipid profile.

Data analysis: The gathered data was imported into SPSS. The statistical package for social sciences (SPSS) version 21 was used to analyse the data. Tables and diagrams are used to present the data after it has been given as percentages in categories. For the significance test, the chi-square test and independent T test were employed. All statistical tests will be deemed statistically significant at a p-value of 0.05.

Results

The study consisted of 72% males and 28% females and the mean age was 52.68± 7.7 years, majority of them presenting with fever, flu, cough, dyspnoea and myalgia. Among the subjects the mean BMI was 27.9± 3.91 suggesting most of them were overweight/obese as shown in Table 1. At recovery the all the subjects were subjected to CT of chest and the findings showed 92% had persistent multifocal ground glass opacities, 46% had crazy paving, 32% had linear opacities and 38% had consolidation with multifocal ground glass opacities (as shown in Figure 1). At recovery majority of the subjects (70%) were able to walk ≥ 100 M and the remaining 30% were unable to walk 100M. The FEV1 was between 70-79% in 605 of the subjects, between 60-69% in 24%, in 10% it was 50-59%, in 4% FEV1 was 35-49% and only in 2% it was <35%. The forced vital capacity (FVC) was above the lower limit in 765 subjects and was below lower limit in 24% subjects. The FEV/FVC was normal in 14 (28%) subjects and in 36 (72%) it was <70 (as seen in Table 2). In the study when severity and PFT was compared a significant difference was obtained between them suggesting decreasing severity improved PFT and vice- versa as seen in Table 3.

Table 1: Socio-demographic and clinical characteristics of the study population

Socio-demographic & clinical characteristics	Frequency	Percentage
Age	52.68± 7.7 years	
Gender		
Male	36	72%
Female	14	28%
BMI	27.9± 3.91	
Clinical symptoms		
Fever	45	90%
Flu/ cold	47	94%

ISSN 2515-8260 Volume 10, Issue 03, 2023

Cough	40	80%
Dyspnoea	43	86%
Myalgia	32	64%
Loss of taste	21	42%
Loss of smell	19	38%

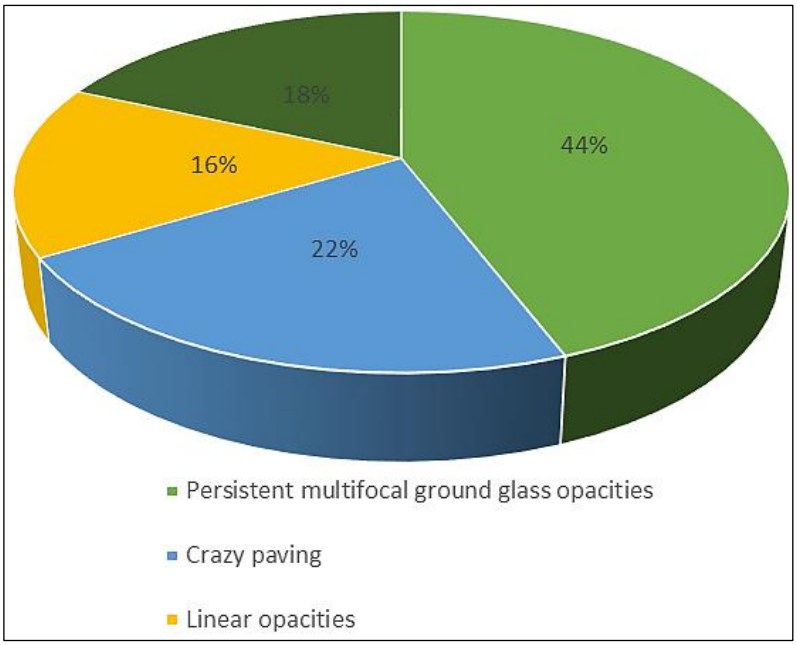

Fig 1: Pie chart showing CT findings at recovery

Table 2: PFT findings at recovery

PFT	Frequency	Percentage
100-meter walk		
<100 M	15	30%
≥ 100 M	35	70%
FEV1		
>80%	-	-
70-79%	30	60%
60-69%	12	24%
50-59%	5	10%
35-49%	2	4%
<35%	1	2%
FVC		
≥ Lower limit	38	76%
< Lower limit	12	24%
FEV1/FVC		
>70 (Normal)	14	28%
<70 ((Abnormal)	36	72%

Table 3: Comparison between severity and pulmonary function test (PFT)

	PFT	Mean	SD	95% CI		p-value
				Lower	Upper	
Severity	100- M walk	1.7	0.46	2.39	2.08	<0.001*
	FEV1	2.6	0.96	1.5	1.09	<0.001*
	FVC	1.24	0.43	2.88	2.51	<0.001*
	FEV1/FVC	1.84	0.37	2.3	1.89	<0.001*
*Level of significance: $p<0.05$						

ISSN 2515-8260 Volume 10, Issue 03, 2023

Discussion

The study carried out showed significant changes in PFT's at recovery which impacted a person daily life directly reducing the quality of life too. In the study the mean age was 52.68± 7.7 years with male predominance which was consistent with studies done by Ngai JC *et al.* [8], Guler SA *et al.* [9], Yu M *et al.* [10] and Zhao YM *et al.* [11] The BMI was 29.8 ± 5.7 and 24.62 ± 3.31 kg/sq m in the studies by Guler SA *et al.* [9] and Zhao YM *et al.* [11] respectively with the earlier study being close to the present study finding. The present study findings were similar to a study by Chen H *et al.* [12] in which the most common symptoms were cough, sputum production, dyspnea, fatigue or myalgia, and headache.

The present study findings were comparable with a study by da Rosa Mesquita R *et al.* [13] in which fever (58.66%), cough (54.52%), dyspnoea (30.82%), malaise (29.75%), fatigue (28.16%) and sputum/secretion (25.33%) were the most common clinical features. Neurological symptoms (20.82%), dermatological manifestations (20.45%), anorexia (20.26%), myalgia (16.9%), sneezing (14.71%), sore throat (14.41%), rhinitis (14.29%), goose bumps (13.49%), headache (12.17%), chest pain (11.49%) and diarrhoea (9.59%) were other common symptoms. A study by Yu M *et al.* [10] in which 59.4% had ground glass opacities, 62.5% had ground glass opacities with consolidation, 56.3% had interstitial thickening and 37.5% had crazy paving. The present study findings were different with a study by Zhao YM *et al.* [11] in which typical features like ground glass opacities (7.2%), interstitial thickening (27.2%) and crazy paving (5.45%) were almost resolved, but evidence of fibrosis, such as interstitial thickening were observed at end of 3 months. Similarities to a study by Huang Y *et al.* [14] in which 54.4% had residual abnormality at 30 days post discharge follow-up. Residual abnormalities included ground glass opacities, pulmonary fibrosis and consolidation.

Huang Y *et al.* [14] study showed 88.4% were able to reach the predicted values of 6 min walking distance. Eksombatchai D *et al.* [15] in which there was patients with severe COVID had shorter six-minute walk distance. The present study findings concurred with a study by Guler SA *et al.* [9] in which the mean FEV1/FVC % was 94.7 ± 13.7 and FEV1 was 2.64 ±0.8 L. The FVC % was 3.28 ± 1.01 L. The present study findings were similar to a study by Huang Y *et al.* [14] in which 75.4% had abnormal pulmonary function tests. Around 10.5%, 8.7% and 43.8% patients FVC, FEV1, FEV1/FVC ratio had values less than 80% of predicted values, respectively. The present study findings were comparable to a study by Li X *et al.* [16] in which mean FVC predicted value was 84.1 ± 15.4% and FEV1 was 84.5 ± 16.3%. The mean FEV1/FVC was 85.2 ± 6.1%.

Conclusion

The study concludes on comparison of severity with PFT a significant difference was noted between them. The study might be limited due to very few previously done studies further large-scale studies are needed to justify the study findings.

Conflict of interest: Nil.

Source of funding: Nil.

References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395:497-506.
2. Ñamendys-Silva SA. ECMO for ARDS due to COVID-19. Hear Heart Lung. 2020;49:348-49.
3. Rai DK, Sharma P, Kumar R. Post COVID-19 pulmonary fibrosis. Is it real threat? Indian J Tuberc. 2021;68:330-33.
4. Venkataraman T, Frieman MB. The role of epidermal growth factor receptor (EGFR) signaling in SARS coronavirus-induced pulmonary fibrosis. Antiviral Res. 2017;143:142-50.

ISSN 2515-8260 Volume 10, Issue 03, 2023

5. Frija-Masson J, Debray MP, Gilbert M, Lescure FX, Travert F, Borie R. Functional characteristics of patients with SARS-CoV-2 pneumonia at 30 days post infection. Eur Respir J; c2020.
6. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R. Interpretative strategies for lung function tests. Eur. Respir J. 2005;26:948-968.
7. Niraj N, Apeksha M, Gauri A, *et al*. Prevalence and clinical presentations of COVID-19 in India. J Assoc Physicians India. 2020;68(12):16-21.
8. Ngai JC, Ko FW, Ng SS, To KW, Tong M, Hui DS. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. Respirology. 2010;15(3):543-50.
9. Guler SA, Ebner L, Aubry-Beigelman C, Bridevaux PO, Brutsche M, Clarenbach C, *et al*. Pulmonary function and radiological features 4 months after COVID-19: first results from the national prospective observational Swiss COVID-19 lung study. Eur. Respir. J 2021;57(4):200-3690.
10. Yu M, Liu Y, Xu D, Zhang R, Lan L, Xu H. Prediction of the Development of Pulmonary Fibrosis Using Serial Thin-Section CT and Clinical Features in Patients Discharged after Treatment for COVID-19 Pneumonia. Korean J Radiol. 2020;21(6):746-55.
11. Zhao YM, Shang YM, Song WB, Li QQ, Xie H, Xu QF, *et al*. Follow-up study of the pulmonary function and related physiological characteristics of COVID-19 survivors three months after recovery. E-Clinical-Medicine. 2020;25:100-463.
12. Chen H, Qin L, Wu S, Xu W, Gao R, Zhang X. Clinical characteristics and laboratory features of COVID-19 in high altitude areas: A retrospective cohort study. PLoS ONE. 2021;16(5):e024-9964.
13. Da Rosa Mesquita R, Francelino Silva Junior LC, Santos Santana FM, Farias de Oliveira T, Campos Alcântara R, Monteiro Arnozo G, *et al*. Clinical manifestations of COVID-19 in the general population: systematic review. Wien Klin Wochenschr. 2021;133(7-8):377-82.
14. Huang Y, Tan C, Wu J, Chen M, Wang Z, Luo L, *et al*. Impact of coronavirus disease 2019 on pulmonary function in early convalescence phase. Respir Res. 2020;21(1):163-65.
15. Eksombatchai D, Wongsinin T, Phongnarudech T, Thammavaranucupt K, Amornputtisathaporn N, Sungkanuparph S. Pulmonary function and six-minute-walk test in patients after recovery from COVID-19: A prospective cohort study. PLoS ONE. 2021;16(9):e025-7040.
16. Li X, Wang C, Kou S, Luo P, Zhao M, Yu K. Lung ventilation function characteristics of survivors from severe COVID-19: a prospective study. Crit Care. 2020;6;24(1):300-02.