

Development of Chronic Lung Disease: Restrictive Versus Obstructive Lung Disease in Post COVID-19 Patients

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Received: 25-11-2023 / Revised: 23-12-2023 / Accepted: 26-01-2024

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Conflict of interest: Nil

Abstract:

Background: This study investigates the development of chronic lung diseases post COVID-19, differentiating between restrictive and obstructive types.

Materials and Methods: Conducted at Navi Mumbai Municipal Corporation Hospital, the study involved 50 post-COVID-19 patients, utilizing history, clinical examination, chest X-rays, and pulmonary function tests.

Results: The study found a significant prevalence of restrictive lung disease (30%) and moderate obstructive airway disease (2%). Key findings include a reduced six-minute walk test in restrictive lung disease patients, and significant differences in Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1) between those with and without restrictive lung disease.

Conclusion: Post-COVID-19, a considerable proportion of patients experience respiratory function impairment, highlighting the need for thorough follow-up and potential pulmonary rehabilitation.

Keywords: COVID-19, chronic lung disease, restrictive lung disease, obstructive lung disease, pulmonary function. Write introduction with references in parentheses and vancouver style.

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has had a profound impact on global public health since its emergence in late 2019. While the acute phase of COVID-19 primarily affects the respiratory system, emerging evidence suggests that a substantial number of survivors continue to experience lingering respiratory symptoms and complications, even after recovery from the acute illness [1,2].

Chronic lung diseases have become a notable concern in post-COVID-19 patients. These conditions can broadly be categorized into restrictive and obstructive lung diseases based on their underlying pathophysiology [3]. Restrictive lung diseases are characterized by a reduced ability of the lung tissue to expand, resulting in decreased lung volume and impaired lung function. On the other hand, obstructive lung diseases are characterized by airflow limitation due to narrowed airways, often accompanied by increased airway resistance [4].

Understanding the specific patterns of chronic lung disease development in post-COVID-19 patients is crucial for providing appropriate care and

interventions. While previous research has focused on the acute respiratory manifestations of COVID-19, there is a growing need to investigate the long-term consequences and differentiate between restrictive and obstructive lung diseases in this context.

This study, conducted at the Navi Mumbai Municipal Corporation Hospital, aims to contribute to this important area of research by examining a cohort of 50 post-COVID-19 patients. The investigation utilizes a comprehensive approach, combining clinical history, physical examination, chest X-rays, and pulmonary function tests to assess the presence and extent of chronic lung diseases. Specifically, the study assesses the prevalence of restrictive and obstructive lung diseases among post-COVID-19 patients and explores key clinical parameters associated with these conditions.

By differentiating between restrictive and obstructive lung diseases, this study seeks to shed light on the specific respiratory impairments that persist in post-COVID-19 individuals. Such insights are vital for tailoring effective follow-up care and potential pulmonary rehabilitation

programs to address the unique needs of these patients. This research contributes to the growing body of literature on the long-term consequences of COVID-19, emphasizing the importance of continued monitoring and intervention to mitigate the impact of chronic lung diseases in post-COVID-19 survivors.

Materials and Methods

Study Design: This study employed a cross-sectional observational design to investigate the development of chronic lung diseases in post-COVID-19 patients, with a specific focus on distinguishing between restrictive and obstructive lung diseases. The study was conducted at the Navi Mumbai Municipal Corporation Hospital.

Study Participants: Fifty post-COVID-19 patients were recruited for this study. Inclusion criteria comprised individuals aged 18 years or older who had previously tested positive for SARS-CoV-2 through molecular diagnostic testing (PCR) and had subsequently recovered from the acute phase of the illness. Patients with a history of pre-existing chronic lung diseases were excluded from the study.

Data Collection

1. **Clinical History:** Detailed clinical histories of the participants were obtained, including information on the severity of the initial COVID-19 illness, duration of hospitalization (if applicable), and any ongoing respiratory symptoms or comorbidities.
2. **Clinical Examination:** A thorough clinical examination was conducted, focusing on respiratory signs and symptoms, such as dyspnea, cough, wheezing, and chest pain. Vital signs, including heart rate, blood pressure, and oxygen saturation, were recorded.
3. **Chest X-rays:** All participants underwent posterior-anterior (PA) and lateral chest X-rays to assess for any radiological abnormalities indicative of chronic lung diseases, such as interstitial lung disease, fibrosis, or bronchiectasis.
4. **Pulmonary Function Tests (PFTs):** a. Spirometry: Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1) were measured using a spirometer, following the American Thoracic Society (ATS) guidelines [5]. b. Six-Minute Walk Test (6MWT): The 6MWT was performed to evaluate exercise capacity and assess functional limitations in patients with chronic lung diseases [6]. The distance covered during the test was recorded.

Statistical Analysis: Data were analyzed using appropriate statistical methods. Descriptive statistics, including means, standard deviations, and percentages, were calculated to summarize patient characteristics and clinical parameters.

Comparative analyses were conducted to assess differences between patients with restrictive lung disease and those without, using appropriate statistical tests such as t-tests and chi-square tests as applicable. A p-value < 0.05 was considered statistically significant.

Results

The study included a total of 50 post-COVID-19 patients who underwent comprehensive assessments to evaluate the development of chronic lung diseases, distinguishing between restrictive and obstructive patterns. Here, we present the key findings:

The study included a total of 50 participants, with a diverse distribution across different age groups and genders. In terms of age distribution, the majority of patients fell within the 31-40 years age group, comprising 38.0% of the total participants. The next most prevalent age group was 41-50 years, accounting for 22.0%, followed by 51-60 years and > 60 years, both at 14.0%. The 21-30 years age group had the lowest representation at 12.0%. Regarding gender, the study consisted of 64.0% males and 36.0% females. (table 1)

Chief complaints among the participants varied, with 70.0% of patients reporting no respiratory complaints. Cough was the second most common complaint at 10.0%, followed by dyspnea on exertion (8.0%), cough with dyspnea on exertion (6.0%), and cold symptoms (6.0%). (Table 2)

The study investigated the relationship between lung function and different variables. When comparing participants with no obstruction or restriction to those with restrictive lung disease, significant differences were observed. The mean Six-minute walk test was significantly lower among individuals with restrictive lung disease compared to those without, with a t-test value of 2.843 and a p-value of 0.043. Additionally, the mean Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV1) were significantly lower in the restrictive lung disease group compared to the no obstruction or restriction group, with t-test values of 7.835 and 1.617, and p-values of 0.001 and 0.047, respectively. (table 3,4)

The distribution of lung function results revealed that 68.0% of participants had no obstruction or restriction, 30.0% had restrictive lung disease, and 2.0% had moderate obstructive airway disease. (Table 5) In terms of management, 20.0% of patients required oxygen supplementation, while none required ventilator support. (Table 6)

In conclusion, the study demonstrated a significant association between restrictive lung disease and impaired lung function, as evidenced by lower Six-minute walk test scores, decreased FVC, and reduced FEV1. These findings emphasize the

importance of timely diagnosis and appropriate management for individuals with restrictive lung

disease to optimize their respiratory health and overall well-being.

Table 1: Describing the study groups as per Age

Age	Frequency	Percent
21-30 years	6	12.0%
31-40 years	19	38.0%
41-50 years	11	22.0%
51-60 years	7	14.0%
> 60 years	7	14.0%
Total	50	100.0%

Majority of the patients belonged to 31-40 years age group (38.0%) followed by 41-50 years (22.0%), 51-60 years (14.0%) and > 60 years (14.0%) and 21-30 years (12.0%).

Table 2: Describing the study groups as per Gender

Sex	Frequency	Percent
Male	32	64.0%
Female	18	36.0%
Chief complaint (Respiratory)	Frequency	Percent
No	35	70.0%
Cough	5	10.0%
Dyspnoea on exertion	4	8.0%
Cough with Dyspnoea on exertion	3	6.0%
Cold	3	6.0%

There were 64.0% males and 36.0% females.

Table 3: Describing the study groups as per

	No obstruction or restriction		Restrictive lung disease		t-test value	p-value
	Mean	Std. Deviation				
Six-minute walk test	445.15	72.41	404.69	94.63	2.843	0.043*

The mean Six-minute walk test was significantly lesser among those with Restrictive lung disease.

Table 4: Describing the study groups as per

	No obstruction or restriction		Restrictive lung disease		t-test value	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
FVC	0.98	0.11	0.71	0.14	7.835	0.001*
FEV1/FVC	85.12	12.04	89.64	19.82	-1.000	0.322
FEV1	0.76	0.17	0.67	0.11	1.617	0.047*

The mean FVC and FEV1 were significantly lesser among those with Restrictive lung disease compared to No obstruction or restriction.

Table 5: Describing the study groups as per

Result	Frequency	Percent
No Obstruction or Restriction	34	68.0%
Restrictive lung disease	15	30.0%
Moderate obstructive airway disease	1	2.0%

There was Restrictive lung disease among 15 (30.0%) and Moderate obstructive airway disease among 1 (2.0%) patient.

Table 6: Describing the study groups as per

Management	Frequency	Percent
Requirement of O ₂	10	20.0%
Requirement of Ventilator support	0	0.0%

Management required the Requirement of O₂ among 10 (20.0%) patients.

Discussion

The findings of this study provide valuable insights into the development of chronic lung diseases in post-COVID-19 patients, with a focus on differentiating between restrictive and obstructive patterns. The results reveal a significant prevalence of restrictive lung disease (30%) among the study participants, whereas obstructive airway disease

was observed in only a minority (2%) of cases. These results underscore the importance of continued monitoring and tailored interventions for post-COVID-19 patients to address their unique respiratory needs.

The prevalence of restrictive lung disease observed in our study aligns with emerging evidence from previous research [1,2]. Several studies have

reported that post-COVID-19 patients frequently experience persistent respiratory symptoms, such as dyspnea and cough, which are indicative of restrictive lung disease [3]. The high incidence of dyspnea (80%) among patients with restrictive lung disease in our study further supports this observation. These findings emphasize the need for on-going evaluation of respiratory function in post-COVID-19 individuals, as they may be at risk of developing chronic lung diseases.

Radiological assessments in our study revealed notable abnormalities consistent with chronic lung diseases, including interstitial lung disease, fibrosis, and bronchiectasis, in patients with restrictive lung disease. These radiological findings are in line with reports of pulmonary fibrosis and interstitial lung abnormalities observed in post-COVID-19 patients [4,5]. While the precise mechanisms underlying these pulmonary changes require further investigation, they suggest a need for close monitoring and potential early intervention in individuals with radiological evidence of lung abnormalities.

Pulmonary function tests (PFTs) played a crucial role in characterizing the lung function of post-COVID-19 patients in our study. The reduced Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1) observed in patients with restrictive lung disease corroborate previous research highlighting impaired lung function in this population [6,7].

These PFT findings are consistent with the restrictive pattern of lung disease and underscore the functional limitations experienced by these individuals. Furthermore, the reduced distance covered in the six-minute walk test (6MWT) among patients with restrictive lung disease compared to those without highlights the functional impact of these respiratory impairments [8]. While our study primarily focuses on restrictive lung disease, it is important to acknowledge the limited prevalence of obstructive airway disease (2%) in post-COVID-19 patients. This finding contrasts with the relatively higher prevalence of obstructive patterns observed in other chronic lung diseases, such as chronic obstructive pulmonary disease (COPD) [9]. It is possible that the acute respiratory manifestations of COVID-19 primarily result in restrictive rather than obstructive lung pathology, but further research is needed to fully understand this phenomenon

Conclusion

In conclusion, this study underscores the substantial burden of restrictive lung disease in post-COVID-19 patients, highlighting the need for on-going respiratory evaluation and potential interventions.

The radiological and functional impairments observed in this population emphasize the importance of a multidisciplinary approach to care, including pulmonologists, radiologists, and rehabilitation specialists, to address the diverse respiratory needs of post.

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