DOI: 10.7860/JCDR/2025/76367.20689

Original Article

Internal Medicine Section

Prediction of Pulmonary Hypertension in Patients with Diffuse Parenchymal Lung Disease using Forced Vital Capacity/ Diffusion Capacity of Lung using Carbon Monoxide Ratio: A Cross-sectional Study

ANUBHAB MOULIK[1], JAYDIP DEB[2], SOURINDRA NATH BANERJEE[3], PRIYANKA RAY[4], PULAK KUMAR JANA[5], SUKANTA KODALI[6], SASWATA GHOSH[7]

ABSTRACT

Introduction: Diffuse Parenchymal Lung Disease (DPLD) comprise a heterogeneous group of diseases that occur when an abnormal healing response is induced by injury to the lungs. The diagnosis of DPLD is based on clinical presentation and radiological features. The initial diagnostic work-up includes Pulmonary Function Tests (PFT), such as spirometry and diffusion tests.

Aim: To evaluate the accuracy of the Forced Vital Capacity/ Diffusion Capacity of Lung for Carbon Monoxide (FVC/DLCO) ratio in predicting the presence of pulmonary hypertension in patients with DPLD.

Materials and Methods: A cross-sectional study was conducted from January 2023 to March 2024 in the Inpatient Department (IPD) and Outpatient Department (OPD) of Nilratan Sircar (NRS) Medical College and Hospital, Kolkata, West Bengal, India. A total of 50 patients underwent High-Resolution Computed Tomography (HRCT) thorax and spirometry with DLCO, along with some other ancillary investigations. The parameters evaluated primarily include a descriptive account of the spirometry values, which were Forced Expiratory Volume in 1 second (FEV1), FVC and DLCO, as well as the 6-Minute Walk Distance (6MWD) for physiological assessment and ECHO 2D for the evaluation of pulmonary hypertension. Simple logistic regression was performed between the FVC/DLCO ratio and the presence or absence of pulmonary hypertension based on ECHO 2D with Doppler as the binary outcome. The Receiver Operating Characteristic (ROC) curve was obtained and the FVC/DLCO cut-off ratio was adjusted to achieve the highest sensitivity for predicting pulmonary hypertension based on this dataset.

Results: Out of 50 patients (30 females and 20 males), the most common HRCT thorax pattern was Usual Interstitial Pneumonia (UIP), observed in 19 patients (38%), followed by Non Specific Interstitial Pneumonia (NSIP) in 11 patients (22%). The single most common DPLD was Idiopathic Pulmonary Fibrosis (IPF), with 11 patients (22%), while the most common group was Connective Tissue Disease-related DPLD (CTD-DPLD), comprising 22 patients (44%). An FVC/DLCO ratio of 0.97 was found to have a sensitivity of 81%, specificity of 77%, a Positive Predictive Value (PPV) of 86%, a Negative Predictive Value (NPV) of 70% and a diagnostic accuracy of 80% in predicting pulmonary hypertension.

Conclusion: The FVC/DLCO ratio of 0.97 represents a modality that could aid in the diagnosis of pulmonary hypertension.

Keywords: Idiopathic pulmonary fibrosis, Systemic sclerosis, Usual interstitial pneumonia

INTRODUCTION

The DPLDs are a group of disorders that involve the space between alveolar epithelial and capillary endothelial basement membranes [1]. The most important part of the work-up for patients with DPLD is detailed and proper history-taking to identify possible aetiologies, including occupational or drug exposures and signs of conditions like Connective Tissue Diseases (CTDs), sarcoidosis and infection [2]. The HRCT of the chest is the gold standard modality for DPLD diagnosis. It provides ten times more resolution than conventional imaging, revealing details that cannot otherwise be visualised [3].

A restrictive pattern is usually seen on spirometry in patients with DPLD [4]. The Diffusing Capacity for Carbon Monoxide Single Breath (DLCO-SB) test is used to assess DPLD, as it indicates thickening of the alveolar membrane and diminished total lung volume due to interstitial processes [5]. To reduce the frequency of performing HRCT during follow-up of patients with DPLD, attempts have been made to correlate HRCT thorax fibrosis with DLCO-SB in DPLD [6]. Among Pulmonary Function Tests (PFTs), DLCO was found to relate better to the extent of disease on HRCT chest scans than spirometry or lung volumes [7]. A baseline low DLCO, independent of histopathological diagnosis, was found to predict reduced survival [8]. Although the majority of DPLDs are known to produce alveolar inflammation and share common physiological abnormalities, some DPLDs are found to affect the large airways, along with the smaller airways and interstitium and are hence presumed to produce distinctive physiological manifestations [9].

DPLDs are often diagnosed clinico-radiologically and the follow-up of these patients involves repeat imaging, which raises concerns about radiation exposure. Spirometry with DLCO may help to address this issue, as it is radiation-free, easy to perform and can be repeated as needed [10].

PFTs are an easy and helpful tool for screening pulmonary vasculopathy in scleroderma patients. They assist in recognising early pulmonary hypertension, which can subsequently be confirmed with further testing [11]. However, pulmonary hypertension remains an important prognostic factor in these patients and it is usually detected using two-dimensional echocardiography with Doppler study. The FVC/DLCO ratio is a novel parameter, albeit one that is still little explored and is primarily used in systemic sclerosis.

This gap in the literature is addressed in this study, which aimed to evaluate the accuracy of the FVC/DLCO ratio in predicting the presence of pulmonary hypertension in patients with DPLD.

MATERIALS AND METHODS

The cross-sectional time-bound study was conducted at NRS Medical College, Kolkata, West Bengal, India, in the respiratory medicine department (IPD and OPD) from January 2023 to March 2024. This study was approved by the IEC (NRSMC/IEC/178/2022). Written informed consent was obtained from every participant. A total of 50 patients diagnosed with DPLD during the study duration were included in the study.

Inclusion criteria: Patients older than 12 years of age with DPLD, either newly or previously diagnosed, who presented with clinical features suggestive of DPLD, such as dry cough, progressive exertional dyspnoea and other symptoms related to the aetiology, as well as radiological evidence on HRCT thorax of different patterns pertaining to DPLDs, were included.

Exclusion criteria: Patients with hepatic, renal, or cardiac co-morbidities that may cause pulmonary venous congestion or affect the pulmonary interstitium, thereby interfering with adequate effort and confounding the results during spirometry with DLCO. Patients recovering from major thoracic, abdominal, head, or ocular surgery. Patients with co-existing neuromuscular diseases and active haemoptysis. Patients with bullous airway diseases evident on HRCT thorax, a likelihood of pneumothorax based on clinical examination and those with significant kyphoscoliosis that may not be attributable to the disease process based on history. Additionally, patients on antitubercular drugs and those experiencing acute exacerbation of DPLD were also excluded from the study.

Study Procedure

Data were collected using case record forms after obtaining informed consent. All patients underwent HRCT thorax and spirometry with DLCO. A general physical examination and history-taking were conducted for all patients, particularly focusing on their smoking history. Some patients underwent serological testing, including Anti-Nuclear Antibody (ANA), ANA profile, Rheumatoid Factor (RF) and anti-Cyclic Citrullinated Peptide (CCP) for CTD-DPLD. Serum Angiotensin Converting Enzyme (ACE), 24-hour urinary calcium and serum calcium were tested in suspected cases of sarcoidosis. For patients with hypersensitivity pneumonitis, a serum hypersensitivity pneumonitis panel was conducted. Bronchoscopy with Broncho-Alveolar Lavage (BAL) fluid analysis was performed for cytology and to rule out infections, including tuberculosis, in some patients. All patients underwent ECHO 2D with Pulmonary Artery Systolic Pressure (PASP) estimation in the department of cardiology. Purposive, non random sampling was performed and patients were selected after being vetted through the inclusion and exclusion criteria.

The parameters studied included a description of the imaging findings on HRCT thorax images and radiological patterns such as UIP, NSIP, organising pneumonia, lymphocytic interstitial pneumonia, etc. Additionally, parameters such as FEV1, FVC, FEV1/FVC ratio and DLCO were noted. ECHO 2D with Doppler studies, with an emphasis on PASP, was also recorded. The 6MWD values were noted in all patients.

STATISTICAL ANALYSIS

Data were entered into MS Excel and analysed using MS Excel and GraphPad Prism software, version 9. Descriptive statistics, such as age distribution, smoking status, gender representation and the distribution of FEV1, FVC, DLCO and 6MWD values, were calculated using the descriptive statistics functions of MS Excel. The tests used included an unpaired t-test and simple logistic regression. A p-value <0.05 was considered statistically significant for this study. Simple logistic regression was performed between the FVC/DLCO ratio and the presence or absence of pulmonary hypertension, based on ECHO 2D with Doppler, as the binary outcome. The ROC curve was obtained and the FVC/DLCO cut-off ratio was adjusted to achieve the highest sensitivity for predicting pulmonary hypertension based on this dataset.

RESULTS

In this study, of the 50 patients, 20 were male (40%) and the remaining 30 were female (60%). The mean age was 49.22±15.64 years. The most common age group was between 45 and 60 years, with 19 patients (38%) [Table/Fig-1]. Out of the total 50 patients, 15 (30%) were ex-smokers or current smokers, while the remaining 35 (70%) were non smokers.

Age (in years)	Total number (n=50)
Mean±SD	49.22±15.64
Range	15-79
Age groups (in years)	n (%)
15-30	7 (14)
30-45	11 (22)
45-60	19 (38)
60-75	11 (22)
>75	2 (4)

[Table/Fig-1]: Age distribution (n=50).

The most common HRCT thorax involvement was honeycombing (21 patients, 42%), followed by predominant reticulation and Ground Glass Opacity (GGO) with subpleural sparing (17 patients, 34%) [Table/Fig-2].

CT thorax description of major pattern	Number (%)
Honeycombing	21 (42)
GGO, subpleural sparing with reticulation	17 (34)
Other patterns	12 (24)

[Table/Fig-2]: CT thorax description of major pattern (n=50).

Other patterns included: two cases with bilateral peripheral predominant subpleural consolidation in a broncho-vascular distribution; four cases with peribronchovascular and fissural nodules with upper lobe predominant reticulation; two cases with bilateral multilobar GGO; one case with bizarre-shaped cysts in the lung with bilateral diffuse involvement; one case with lower lobe predominant cystic spaces with para-mediastinal cysts; one case with basal honeycombing and upper lobe predominant emphysema; and one case with cysts superimposed on GGO in a lower lobe predominant distribution with subpleural sparing. The most common overall pattern was the UIP pattern on HRCT thorax [Table/Fig-3].

Radiological pattern	Number (%)
Usual Interstitial Pneumonia (UIP)	19 (38)
Non Specific Interstitial Pneumonia (NSIP)	11 (22)
Perilymphatic and fissural nodules	5 (10)
Fibrosis with mosaic attenuation predominantly involving upper lobes	3 (6)
Other patterns	12 (24)

[Table/Fig-3]: CT thorax final radiological pattern (n=50).

Other patterns included one case of Combined Pulmonary Fibrosis with Emphysema (CPFE), three cases of cystic DPLD, two cases of diffuse alveolar hemorrhage characterised by bilateral diffuse GGO, two cases of probable UIP, two cases of organising pneumonia characterised by peripheral pleural-based multifocal consolidation and two cases with an unclassifiable pattern. CTD-DPLD was the most common overall diagnosis (22 patients, 44%), followed by IPF (11 patients, 22%) [Table/Fig-4].

The mean DLCO adjusted for IPF patients was 8.5909±4.5302, while in non IPF patients, the mean DLCO adjusted was 13.8513±10.7887.

DPLD type	Number (%)
Idiopathic Pulmonary Fibrosis (IPF)	11 (22)
Connective Tissue Disease Related DPLD (CTD-DPLD)	22 (44)
Sarcoidosis	5 (10)
Chronic hypersensitivity pneumonitis	3 (6)
Idiopathic pulmonary haemosiderosis	2 (4)
Pulmonary langerhans cell histiocytosis	2 (4)
Cryptogenic Organising Pneumonia (COP)	1 (2)
Combined Pulmonary Fibrosis with Emphysema (CPFE)	1 (2)
Silicosis	1 (2)
Unclassifiable	2 (4)

[Table/Fig-4]: Final DPLD diagnosis (clinico-radiological and serology tests as applicable) (n=50).

The difference in means, evaluated using an unpaired t-test with Welch's correction, was statistically significant (p-value=0.0217). The difference in means between 6MWD was also statistically significant (p-value=0.0028) [Table/Fig-5].

Type of DPLD	DLCO (in mL/min/mm Hg) mean±SD	6MWD (m) mean±SD
IPF	8.59±4.53	222.55±73.79
Non IPF	13.85±10.78	320.1±123.10
p-value	0.0217	0.0028

[Table/Fig-5]: IPF vs non IPF 6MWD and DLCO (n=50).

The most common spirometry curve pattern was restrictive (38 patients, 76%), followed by a mixed defect in eight patients (16%). The obstructive pattern was noted in two patients with sarcoidosis and one patient with pulmonary Langerhans cell histiocytosis, while one patient with idiopathic pulmonary haemosiderosis had a normal flow-volume loop [Table/Fig-6].

Flow volume loop pattern	Number (%)
Restrictive	38 (76)
Mixed	8 (16)
Obstructive	3 (6)
Normal	1 (2)

[Table/Fig-6]: Flow volume loop (n=50).

The difference in means was statistically significant for 6MWD and DLCO parameter, while it was not statistically significant for the FVC/DLCO ratio [Table/Fig-7]. No statistically significant difference in mean values was observed between the IPF and non IPF groups in FEV1, FVC values and the FEV1/FVC ratio [Table/Fig-8].

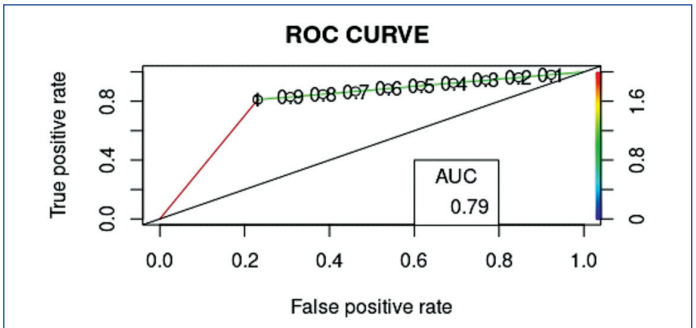
Presence of pulmonary hypertension on echo 2D	6MWD (mean±SD) in metres	FVC/DLCO ratio (mean±SD)	FVC (mean±SD) in mL	DLCO (mean±SD) in mL/min/mm Hg
Yes (37 out of 50 patients, 74%)	298.86±128.23	1.98±1.49	1478.83±498.01	10.31±8.20
No (13 out of 50 patients, 26%)	298±100	1.46±1.02	1737.69±517.33	19.47±11.68
p-value	0.0004	0.1836	0.1216	0.0187

[Table/Fig-7]: Pulmonary hypertension and 6MWD in metres (n=50).
Unpaired t-test with Welch's correction was used

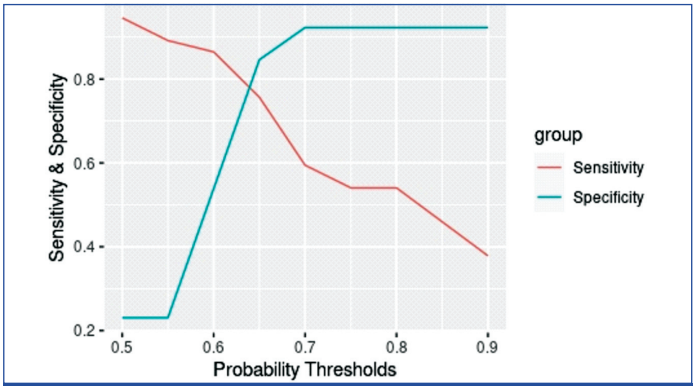
Diagnosis	FEV1 (Mean±SD) in mL	FVC (Mean±SD) in mL	FEV1/FVC ratio
IPF	1216.34±439.14	1550.72±574.26	0.79±0.05
Non IPF	1230.35±355.16	1537.25±500.68	0.80±0.07
p-value	0.9240	0.9447	0.4027

[Table/Fig-8]: Diagnosis and spirometry parameters (n=50).
Unpaired t-test was used

The FVC/DLCO ratio of patients with and without pulmonary hypertension was analysed using a simple logistic regression test. Since this ratio serves as a screening test, a probability threshold providing the highest sensitivity was chosen. A ratio of 0.97 was determined to predict the presence of pulmonary hypertension, while a value lower than that was used to infer the absence of pulmonary hypertension. Based on this dataset and model, the analysis reached a sensitivity of 81%, specificity of 77%, PPV of 86%, NPV of 70% and diagnostic accuracy of 80% [Table/Fig-9,10].



[Table/Fig-9]: ROC plot (n=50).



[Table/Fig-10]: Sensitivity and specificity plot (n=50).

DISCUSSION

The DPLDs are a heterogeneous group of diseases whose incidence increases with age [12]. This study was performed to gain insight into the functional status of DPLD patients using spirometry with DLCO, as well as an evaluation of pulmonary hypertension from the FVC/DLCO ratio, if feasible, thus attempting to supplement 2D-ECHO, which is often operator-dependent. The 6MWD was also conducted as part of the physiological assessment and is a valuable tool in assessing prognosis and evaluating the need for pulmonary rehabilitation [13], an often overlooked area in these patients.

In this study, female patients comprised 60% of the sample size, which contrasts with the findings published by Tentu AK et al., in which the majority of patients (72%) were male. A possible explanation for this finding could be a hospital-based selection bias [14]. The most common age group in this study was 45-60 years, with 19 patients (38%), which corroborates with Tentu AK et al.'s finding, where the most common age was around 50 years (78%) [14]. The most common spirometry loop pattern was restrictive (76%), which was similar to the findings of Balas Z et al., [15].

The most common DPLD in this study was CTD-DPLD, which comprised 22 out of 50 cases, or 44%. This contrasts with the findings of the Indian Interstitial Lung Disease (ILD) registry, which observed that the most common ILD was hypersensitivity pneumonitis, followed by CTD-ILD and Idiopathic Pulmonary Fibrosis (IPF) [16]. This contrasting finding in present study could be explained by hospital-based bias and the limited sample size used in this study, in contrast to the Indian DPLD registry of 1,084 patients. The prevalence of CTDs was found to be higher in association with DPLD than in the general population [17]. The most common DPLD CT involvement was honeycombing with subpleural involvement and GGO with reticulation (38 cases, 76%). Xaubet A et al., described a moderate correlation between abnormalities on HRCT thorax in

39 treated IPF patients and their corresponding DLCO and FVC values [18]. There was no statistically significant difference in the mean FEV1, FVC and FEV1/FVC ratio between the IPF and non IPF groups, which could be due to the heterogeneous nature of patients in the groups, sampling bias, non randomisation and the discrepancy in subgroup sample size.

Out of a total of 50 patients, 15 (30%) had exposure to smoking, while the remaining 35 (70%) were never smokers, which contrasts with the findings of Patel S et al., where a smoking proportion of 61% among the study population was reported [19]. The difference in 6MWD between patients with pulmonary hypertension and those without corroborated the findings of Andersen CU et al., in which, out of 212 patients, a 6MWD of less than 345 m was independently associated with pulmonary hypertension [20]. The FVC/DLCO ratio is a novel parameter and is mostly described for systemic sclerosis DPLD. In this study, an FVC/DLCO ratio of 0.97 predicted pulmonary hypertension as evaluated on ECHO2D, with a sensitivity of 81%, specificity of 77%, a positive predictive value of 86%, a negative predictive value of 70% and a diagnostic accuracy of 80%. This was in contrast to the cut-off of 1.39 as advocated by Eid D et al., [21]. However, the latter study only dealt with patients with systemic sclerosis and pulmonary hypertension, while this study included different DPLD patients with and without pulmonary hypertension.

Limitation(s)

The study was conducted at a single centre in a tertiary care hospital, so hospital bias cannot be ruled out. It was carried out in the IPD and OPD of respiratory medicine, which may introduce an element of selection bias. Additionally, since this was a cross-sectional study, it was not possible to assess prognosis.

CONCLUSION(S)

The most common DPLD encountered in the study was connective tissue disease-associated DPLD (CTD-DPLD), followed by IPF and sarcoidosis, in that order. An FVC/DLCO ratio of 0.97 serves as a good cut-off for predicting pulmonary hypertension in these patients.

Acknowledgement

I am grateful to my parents for their support and my teachers for their constant guidance. I am grateful to my colleagues and my juniors for their unwavering support without whom this work would not have seen the light of day. I am grateful to Dr. Angira Dasgupta madam, pulmonologist at B.R Singh Hospital, Kolkata for igniting the passion for biostatistics in me.

REFERENCES

[1] American Thoracic Society, European Respiratory Society. American Thoracic Society/European Respiratory Society International Multidisciplinary Consensus Classification of the Idiopathic Interstitial Pneumonias. Am J Respir Crit Care Med. 2002;165:277-304.
[2] Oldham M, Adegunsoye A, Valenzi E, Lee C, Witt L, Chen L, et al. Characteristics of patients with interstitial pneumonia with autoimmune features. Eur Respir J. 2016;47(6):1767-75.
[3] Sverzellati N, Desai S. Radiology in diffuse parenchymal lung disease and lung nodules. Eur Respir Rev. 2017;26(144):170049. Available from: https://doi.org/10.1183/160006170049-2017.
[4] Hieba EG, Shaimaa EE, Dina SS, Noha AO. Diffusion lung capacity for carbon monoxide correlates with HRCT findings in patients with diffuse parenchymal lung disease. Egypt J Bronchol. 2020;14:39. Available from: https://doi.org/10.1186/s43168-020-00042-x.
[5] Riad N, Morshedy N, Shoukri A. Role of pulmonary function tests in screening pulmonary arterial hypertension in scleroderma. Egypt J Bronchol. 2015;9:287-92.
[6] Watters LC, King TE, Schwarz MI, Waldron JA, Stanford RE, Cherniack RM. A clinical, radiographic, and physiologic scoring system for the longitudinal assessment of patients with idiopathic pulmonary fibrosis. Am Rev Respir Dis. 1986;133:97-103.
[7] Wells AU, Hansell DM, Rubens MB, King AD, Cramer D, Black CM, et al. Fibrosing alveolitis in systemic sclerosis: Indices of lung function in relation to extent of disease on computed tomography. Arthritis Rheum. 1997;40(7):1229-36. Epub 1997/07/01.
[8] Jegal Y, Kim DS, Shim TS, Lim CM, Do Lee S, Koh Y, et al. Physiology is a stronger predictor of survival than pathology in fibrotic interstitial pneumonia. Am J Respir Crit Care Med. 2005;171(6):639-44. Epub 2005/01/11.
[9] Lama VN, Martinez FJ. Resting and exercise physiology in interstitial lung diseases. Clin Chest Med. 2004;25(3):435-53. v. Epub 2004/08/28.
[10] Bhattacharyya P, Mukherjee S, Mukherjee A, Paul M, Sengupta S, Dey D, et al. Etiological profile and evaluation of DPLD in real-world: The perceived impression of the ILD treating doctors in India. J Assoc Chest Physicians. 2022;10(2):75-80. Doi: 10.4103/jacp.jacp_5_22.
[11] Halasan C, Korzan F, Datta D. Comparison of FVC. FVC/DLCO and TLC/DLCO as an indicator for ILD in patients with Scleroderma. Chest. 2018;154(4):448.
[12] Ahmed HG, Alanazi TAS, Anazi HAA, Alfaraj AFA, Alshammary FMF, Alsunidy KA, et al. Prevalence of diffuse parenchymal lung disease (DPLD) and associated fibrosis in Northern Saudi Arabia. Int J Sci Res. 2013;4(5):1380-82.
[13] Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American Thoracic Society technical standard: Field walking tests in chronic respiratory disease. Eur Respir J. 2014;44:1428-46. Doi: 10.1183/09031936.00150314.
[14] Tentu AK, Singh S, Laxmivandana R, Singh SK. Role of pulmonary function tests in the assessment of lung impairment in patients with diffuse parenchymal lung diseases: Association with Clinicoradiological-histopathological profile. J Clin Diag Res. 2018;12(11):OC06-OC11.
[15] Balas Z, Wagh V, Nagaonkar V. Study of spirometry in ILD patients and its correlation with clinical and radiological profile. J Assoc Physicians India. 2022;70(4):11-12. PMID:35443640.
[16] Singh S, Collins BF, Sharma BB, Joshi JM, Talwar D, Katiyar S, et al. Interstitial lung disease in India. Results of a prospective registry. Am J Respir Crit Care Med. 2017;195(6):801-13.
[17] Gaubitz M. Epidemiology of connective tissue disorders. Rheumatology (Oxford). 2006;45(Suppl 3):iii3-4. Epub 2006/09/22.
[18] Xaubet A, Agusti C, Luburich P, Roca J, Montón C, Ayuso MC, et al. Pulmonary function tests and CT scan in the management of idiopathic pulmonary fibrosis. Am J Respir Crit Care Med. 1998;158:431-36.
[19] Patel S, Maulik J, Trivedi A, Patel R. Role of HRCT thorax in Interstitial Lung disease (A Study of 100 patients).Int J Sci Res. 2024;13(6):1892-1901.
[20] Andersen CU, Mellemkjær S, Hilberg O, Nielsen-Kudsk JE, Simonsen U, Bendstrup E. Pulmonary hypertension in interstitial lung disease prevalence, prognosis and 6 minute walk test. Respir Med. 2012;106(6):875-82.
[21] Eid D, Makhlouf HA, Mohamed-Hussein AAR. Evaluation of FVC/DLCO ratio as a predictor for pulmonary hypertension in patients with interstitial lung diseases. European Respiratory Journal. 2017;50:PA861.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Trainee, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
2. Professor and Head, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
3. Associate Professor, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
4. Assistant Professor, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
5. Professor, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
6. Assistant Professor, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.
7. Associate Professor, Department of Respiratory Medicine, Nilratan Sircar Medical College, Kolkata, West Bengal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anubhab Moulik,
65-H, Moore Avenue, Kolkata-700040, West Bengal, India.
E-mail: moulikanubhab@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 18, 2024
- Manual Googling: Dec 26, 2024
- iThenticate Software: Jan 20, 2025 (13%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Oct 17, 2024**
Date of Peer Review: **Nov 22, 2024**
Date of Acceptance: **Jan 22, 2025**
Date of Publishing: **Mar 01, 2025**