



CORRELATION OF PULMONARY FUNCTION TEST WITH HRCT IN INTERSTITIAL LUNG DISEASES

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ABSTRACT

Background: Interstitial Lung Diseases (ILD) are a group of diffuse parenchymal lung diseases associated with substantial morbidity and mortality. ILD is an umbrella term for a large group of disorders that cause scarring (fibrosis) of lungs. The scarring causes stiffness in the lungs which makes it difficult to breathe. Some examples of ILD includes: Idiopathic pulmonary fibrosis, Hypersensitivity pneumonitis, Sarcoidosis, Asbestosis. **Aim of this study:** Aim of this study is to correlate the HRCT Thorax patterns and extent of involvement of ILD with pulmonary function test (PFT) and Six minute walk test (6MWT). **Patients and Methods:** This is a cross sectional study design which was conducted upon 60 patients of Interstitial Lung Diseases who were receiving medical treatment from Sir Sunderlal Hospital, BHU between July 2020 to June 2022. They are classified into 3 groups on the basis of predominant pattern on HRCT Thorax: a) Group I- Fibrotic Pattern, b) Group II- Ground glass pattern, c) Group III- Nodular pattern. Pulmonary function test including FEV1, FVC, FEV1/FVC, Six Minute Walk Test were done for all patients. **Results:** In this study total 60 patients with ILD were included, most of them were male (58.3%). 40% of the study population were smokers and mean age of study population was 51.06 years. Fibrotic pattern is more frequent HRCT pattern found in the study population (46.6%) followed by ground glass pattern (38.3%). Forced vital capacity (FVC) is lower in fibrotic pattern while FEV1/FVC ratio is lower in nodular pattern (FEV1 = Forced expiratory volume in first second). Six minute walking distance (6MWD) is lower in fibrotic pattern. **Conclusion:** HRCT Thorax patterns and degree of lung involvement in ILD have direct relation with pulmonary function tests. Lung volumes and Six minutes walking distance are lower in fibrotic pattern.

KEYWORDS: ILD, PFT, HRCT, 6MWT, FVC, FEV1.

INTRODUCTION

ILD comprises of a heterogenous group of disorders (such as Idiopathic pulmonary fibrosis, Hypersensitivity pneumonitis, sarcoidosis, Autoimmune ILDs, Asbestosis) characterised by lung parenchymal impairment, inflammation, and fibrosis. Dyspnea is a hallmark and disabling symptom of ILDs. Patients with ILDs may also exhibit skeletal muscle dysfunction, oxygen desaturation, abnormal respiratory patterns, pulmonary arterial hypertension (PAH) and decreased cardiac function, contributing to exercise intolerance and limitation of day-to-day activity.^[1,2] ILD is characterised by exertional dyspnea, interstitial patterns on HRCT and restrictive pattern in pulmonary function testing.^[3]

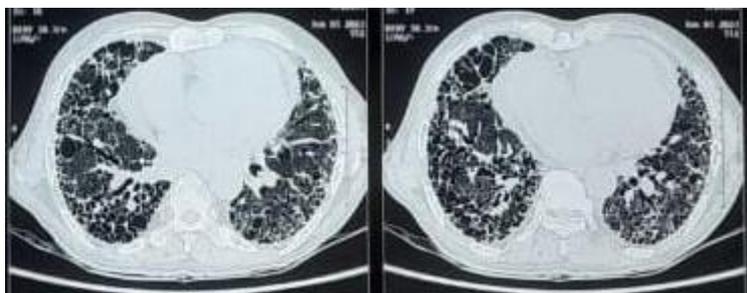
Recent classification of ILD divides these disorders into 5 categories: I) Idiopathic interstitial pneumonias, II) Autoimmune ILDs, III) Hypersensitivity pneumonitis, IV) Sarcoidosis, V) Other ILDs.^[4] Of these ILDs usual interstitial pneumonias (UIP) and non-specific interstitial pneumonias (NSIP) are the most common patterns.^[5] The most common HRCT patterns seen in ILDs are Linear/Reticular opacities, Ground glass opacities, Cystic lesions and Nodular pattern. PFT is useful in diagnosis and management of ILD.^[6] PFT also helps in assessment of severity of lung involvement.

The aim of this study is to correlate radiological pattern and extent of involvement of ILD with PFT and 6 minute walk test.

Patients and Methods

This is a cross-sectional study conducted upon 60 patients of ILD in Sir Sunderlal Hospital, BHU. Their HRCT thorax had one or more of the following patterns: I) Fibrotic pattern (Reticular and/or honey combing), II) Ground glass pattern, III) Nodular pattern. They were evaluated clinically, routine tests were done. PFT and HRCT Thorax were performed.

Exclusion criteria includes pregnancy, any chronic respiratory illness, malignancy or infective diseases and hemodynamically unstable patients. They were classified into above 3 groups according to their predominant patterns on HRCT Thorax.



Fibrotic Pattern

All 60 patients were evaluated for various clinical parameters. A thorough history and examination was done. HRCT Thorax was done, scans were evaluated by radiologist. According to extent of involvement on HRCT Thorax a quantitative scale was used. Findings are categorised as following: **Grade I**- Minimal disease (3-4 septal lines), **Grade II** – Mild disease (> 4 septal lines with reticulations and ground glass opacifications), **Grade III** – Moderate disease (Grade II findings along with tractional bronchiectasis and peribronchovascular thickening with more than one third to two third lung involvement), **Grade IV** – Severe disease (Grade II & III findings with more than two third lung involvement).

Pulmonary function test (spirometry and 6MWT) was done in all patients. FEV1, FVC and FEV1/FVC ratio is measured. 6MWT was performed in all patients to measure six minute walking distance and percentage desaturation. Oxygen saturation was measured via pulse oximetry.

Statistical Analysis

Data were recorded on a predesigned proforma and managed on an excel spread sheet. Descriptive statistics done and mean and SD was calculated. Correlation was assessed using Spearman rank coefficient and statistical significance was accepted at p value < 0.05. Statistical analysis was done using Microsoft excel and IBM statistical package for the social science (SPSS), for windows version 23.0 (IBM corp, ARMONK, NY).

RESULTS

In this study total 60 patients were studied, their demographic data are illustrated in Table 1, where their mean age is 51.06 years and most of the patients were male (58.3%). 40% of the study population were smokers. Figure 1 shows that most frequent HRCT pattern of studied group was fibrotic pattern (46.6%) followed by ground glass appearance (38.3%). 15% patients of study population were of nodular pattern on HRCT Thorax.

Table 1: Demographic Data.

Age (years) (Mean \pm SD)	51.06 \pm 7.8
Sex (Number & %)	
-Male	35 (58.33%)
-Female	25 (41.67%)
BMI (Mean \pm SD)	25.18 \pm 3.21
Smoking (Number & %)	
-Smoker	24 (40%)
-Non-Smoker	36 (60%)

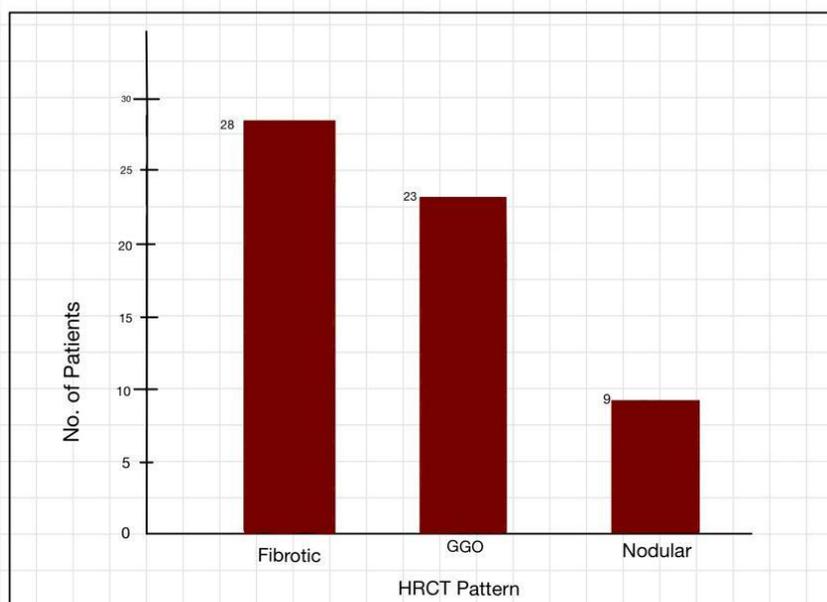


Figure 1: HRCT patterns in 60 studied patients.

Table 2 represents that fibrotic pattern is more common among smokers (66.6% smoker patients were of fibrotic

pattern) while ground glass pattern and nodular pattern are more common among non-smokers (P value <0.05).

Table 2: Correlation of HRCT pattern with smoking status.

HRCT	Smokers (n=24)		Non-Smoker (n=36)		Total		P-Value
	No. of Patients	%	No. of Patients	%	No. of Patients	%	
Fibrotic	16	66.67	12	33.33	28	46.67	0.03
Ground Glass	6	25	17	47.22	23	38.33	0.03
Nodular	2	8.33	7	19.44	9	15	0.03
Total	24	100.00	36	100.00	60	100.00	

In correlation of HRCT with PFT in ILD patients we found FEV1/FVC ratio is lower in nodular pattern as compared to fibrotic and ground glass pattern. FVC is

lower in both fibrotic and ground glass pattern. 6MWD is found slightly lower in fibrotic pattern as compared to ground glass pattern and nodular pattern (p value <0.05).

Table 3: Correlation of HRCT with Pulmonary function variables in mild ILD patients.

Parameter	Mild ILD (n=9)						P-Value
	Fibrotic (n=4)		Ground Glass (n=3)		Nodular (n=2)		
	Mean	SD	Mean	SD	Mean	SD	
FEV1/FVC	87	1.82	84.33	1.52	75	1.41	0.0005
FVC	56.05	1.25	63.3	1.52	55	1.41	0.0007
6MWD	287.5	15	350	17.32	325	21.21	0.008

Table 4: Correlation of HRCT with Pulmonary function variables in moderate ILD patients.

Parameters	Moderate ILD (n=21)						P- Value
	Fibrotic (n=10)		Ground Glass (n=7)		Nodular (n=4)		
	Mean	SD	Mean	SD	Mean	SD	
FEV1/FVC	85.3	1.15	85.57	2.29	73.75	3.4	0.0001
FVC	48.4	2.31	58.85	1.95	53	3.55	0.0001
6MWD	258.4	10.05	305.71	9.75	307.5	26.29	0.0001

Table 5: Correlation of HRCT with Pulmonary function variables in severe ILD patients.

Parameters	Severe ILD (n=30)						P-Value
	Fibrotic (n=14)		Ground Glass (n=13)		Nodular (n=3)		
	Mean	SD	Mean	SD	Mean	SD	
FEV1/FVC	82.85	1.79	85.69	1.88	65.66	1.52	0.0001
FVC	39.14	1.65	53.61	2.43	43	4.35	0.0001
6MWD	228.28	10.72	259.23	13.82	273.3	5.77	0.0001

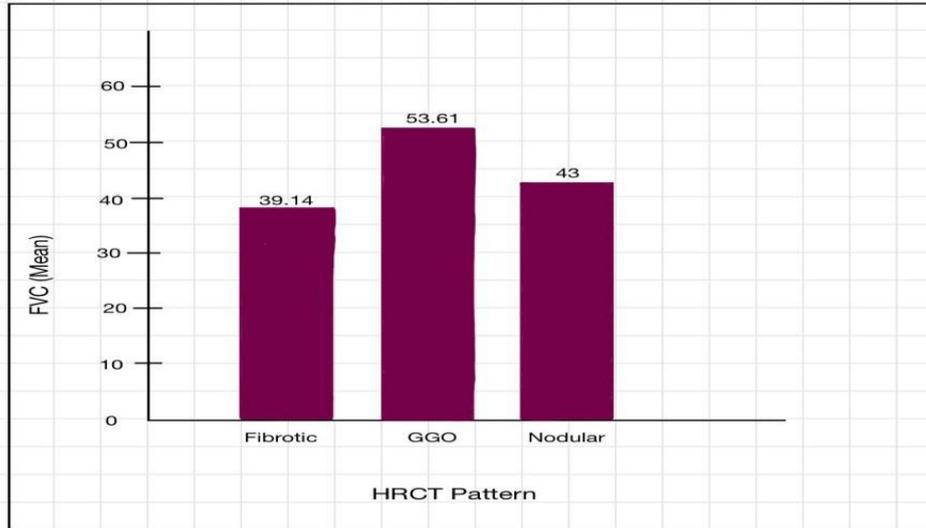


Figure 2: Correlation of Forced vital capacity (FVC) with HRCT patterns in severe ILD patients.

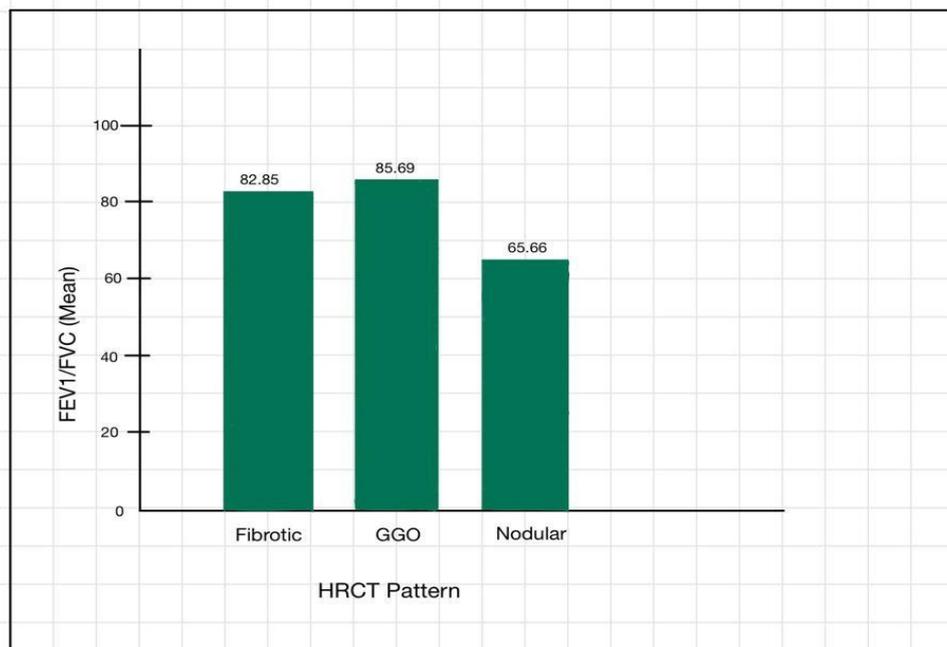


Figure 3: Correlation of FEV1/FVC with HRCT patterns in severe ILD patients.

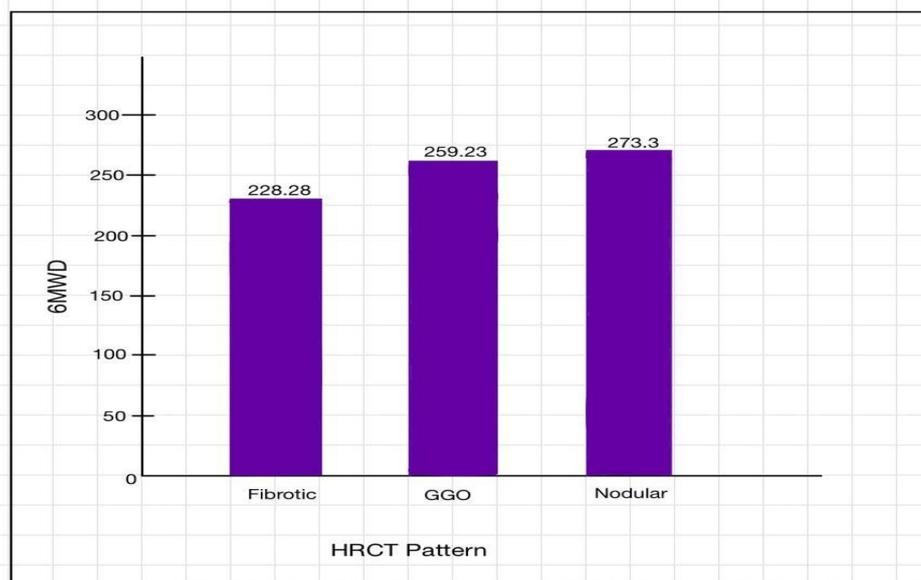


Figure 4: Correlation of 6MWD with HRCT patterns in severe ILD patients.

DISCUSSION

Interstitial lung diseases or Diffuse parenchymal lung diseases are a group of heterogeneous disorder characterised by varying degree of inflammation and fibrosis in lung parenchyma.^[7] The characteristic HRCT findings of reticular abnormality and honey combing with basal and peripheral predominance are virtually diagnostic in the correct clinical context of Usual interstitial pneumonia.^[8] Many investigators have attempted to use PFT to differentiate the patterns of ILD. The identification of relatively raised residual volume in hypersensitivity pneumonitis compared with IPF was detected.^[9]

We found that majority (41.6%) patients were of age group 41-60 years. The mean age for our study was 51.06 years. Our study was male dominated with 58.3%. The mean BMI for our study group was 25.18 kg/m². We correlated HRCT patterns with smoking status. Majority (66.6%) smoker patients were fibrotic followed by 25% of ground glass pattern. We found significant difference between both groups as P-value <0.05.

Khaled et al found that fibrotic pattern was significantly more frequent among smokers while both ground glass pattern and nodular pattern were significantly more frequent among non-smokers. 70% of the patients with fibrotic pattern were current smokers and it may be attributed to IPF.^[10]

We found that FVC is lower in fibrotic pattern as compared to ground glass pattern and nodular pattern. FEV1/FVC ratio is found lower in nodular pattern. 6MWD is decreased in fibrotic pattern (p value <0.05).

There are 8 studies^[11-13, 14-18] which have looked the correlation of HRCT and PFT. Seven^[11, 14-18] of eight studies have shown good correlation and other revealed moderate correlation between HRCT and PFT.^[12] The later study^[12] has used a histogram of HRCT whereas the others have used the HRCT scores. 2 studies had looked at 6MWT and its correlation with HRCT.^[14,15]

In a study of 39 patients by Xaubet et al^[11], the PaO₂ at peak exercise was found to correlate with ground glassing and overall HRCT with P-value of 0.02 and 0.01 respectively.

FVC have been shown to correlate well with two previous study. In study by Xaubet et al, FVC correlated better with ground glassing (r= -0.58) than with overall score (r= -0.46). The study by Mura et al^[15], also found good negative correlation of both TLC and FVC with HRCT scores.

CONCLUSION

Our study was a cross-sectional study design to evaluate 60 patients (Mean age – 51.06 years, 41.67% female) of ILD. HRCT pattern and severity of lung involvement are related with pulmonary function variables. FVC is lower in fibrotic pattern while FEV1/FVC ratio is lower in nodular pattern. 6MWD is lower in fibrotic pattern. Cough and breathlessness were most common symptoms, bilateral crepitation was the most common sign and restriction was the most common spirometry pattern.

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