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Original Research Paper

Radio-Diagnosis

CROSS SECTIONAL STUDY OF CORRELATION BETWEEN HRCT SEVERITY SCORE AND SPIROMETRY INDICES IN DIFFUSE PARENCHYMAL LUNG DISEASES.

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ABSTRACT

Objectives:

- To grade the severity of Diffuse Parenchymal Lung Diseases by HRCT and Correlate the HRCT Severity with Spirometry indices.
- To predict the performance of carbon monoxide diffusion capacity (DLCO) for associated HRCT findings in the detection of diffuse parenchymal lung diseases.

Conclusion And Results

A Cross sectional study was conducted at radiology department of tertiary healthcare hospital in Central India for 2 years study period in patients suffering from diffuse lung disease.

The results are summarised below:

- The highest frequency of age was 50-60 years (36.7%) followed by 60-70 years age (33.3%) and 40-50 years age (13.3%). Mean age was 57.83 year.
- Maximum patients were male (70%).
- Maximum patients had breathlessness (86.7%), cough (76.7%) and chest pain (56.7%).
- Only few patients had fever (20%), history of smoking (30%), h/o infection (13.3%) and systemic disease (16.7%)
- Maximum patients had UIP (46.7%) followed by NSIP (23.3%) and RB ILD (13.3%).
- Mean FVC was 66.131, mean FEV1 was 56.47 %, mean FEV1/FVC was 0.81% and mean DLCO was 49.67 mL/min/mm Hg.
- Maximum patients had restrictive (76.7%) followed by normal (20%) and obstructive (3.3%).
- Normal interpretation (6) was seen in DSIP (1), SCLERODERMA-ILD (2) and UIP (3). Obstructive interpretation (1) was seen only in RB ILD (1). Restrictive interpretation was seen higher in NSIP (7), RB ILD (3) and UIP (11). Comparison between interpretation and diagnosis was showed statistically significant results.
- Total score was higher in restrictive (30.87) followed by obstructive (20) and normal (19.5). Comparison between interpretation and total score was showed statistically significant results.
- Comparison between interpretation and spirometry profile (every parameter) showed statistically significant results.
- Higher total score was showed in POST COVID FIBROSIS NSIP (36), SARCOIDOSIS (32), NSIP (31) and UIP (29.86). Comparison between interpretation and total score was showed statistically significant results.

INFERENCE: The patients included in the study were distinguished patients with diffuse parenchymal lung diseases from those with normal lungs, correlated closely with both 2D analysis and visual quantitation. This study shows that cough, restrictive, FVC, DLCO have statistically significant correlation with total HRCT score in patients with diffuse parenchymal lung diseases. FCV correlated the best with HRCT. DLCO also showed correlation with HRCT in patients with diffuse parenchymal lung diseases.

KEYWORDS : FEV1, FCV, TLC, DLCO, DPLD and UIP.

INTRODUCTION

Diffuse parenchymal lung diseases (DPLD) are a group of different lung diseases that have similar clinical, roentgenographic, physiological or pathological symptoms. These lung diseases are also called "interstitial lung diseases" (ILD). DPLD change how the lungs move and how they exchange gases. In general, DPLD is marked by restrictive changes in pulmonary physiology, such as a decrease in total lung capacity, residual volume, static compliance, vital capacity and often an increase in the FEV1/FVC ratio and a decrease in carbon monoxide diffusion capacity.

Patients with CVD who have diffuse parenchymal lung disease have getting worse parenchymal fibrosis and gas exchange. In its early stages, it isn't dangerous because most people with rheumatism have limited mobility and mild or no pulmonary symptoms. So the respiratory doctor should be careful to make a diagnosis as soon as possible. Because pulmonary specialists often take care of these patients, they need to know a lot about collagen vascular disease and how Diffuse Parenchymal Lung Diseases usually progress.

High-resolution CT (HRCT) is used to measure the severity of diffuse interstitial lung disease (DILD), especially idiopathic interstitial pneumonias. Also, HRCT is useful for predicting the clinical outcomes of idiopathic pulmonary fibrosis (IPF) because the HRCT scoring of fibrosis correlates well with the mortality rate. But most of the time, radiologists look at a medical image and look for specific disease patterns to judge how bad a disease is based on what it looks like on an HRCT. Most of the time, a correct global diagnosis of parenchymal lung disease can only be made 40–70% of the time, and only 76–85% of the time by two experienced readers. Interobserver variation of 81 percent (kappa of 0.48) and intra-observer variation of the same amount (kappa of 0.37 to 0.78) have been found in other studies that looked at the type of lung pattern. Remy-Jardin et al. and Copley et al. have both suggested other ways to score things based on how they look. However, in their studies the reproducibility of the scoring systems was not assessed and their scoring systems were semi-quantitative methods. Therefore, an automated classification system is necessary for objective and reproducible assessment of disease extent.

HRCT is widely recognized as a sensitive and specific modality for the assessment of diffuse lung processes, most

notably the idiopathic interstitial pneumonias, eosinophilic lung diseases, and obstructive lung diseases.

HRCT is a sensitive modality, but it has limits on how much radiation can be used, so it can't be used on pregnant women or children. It is also not offered at the primary or secondary levels of health care. Radiation exposure is not a risk with spirometry, which is a good thing. It's a low-cost alternative to HRCT, and it doesn't need to be read by an experienced radiologist. It is also important because it gives a fair assessment of pulmonary function, which is something that HRCT cannot do.

Over the past few years, the abnormal patterns of DPLD on High Resolution Computerised Tomography (HRCT) scans have been improved and are becoming more widely known as diagnostic patterns. This has led to more people getting HRCT scans along with a thorough clinical evaluation. Pulmonary function tests (PFT) show that the severity of physiologic problems in DPLD is related to the overall severity of pathologic and HRCT problems. Pulmonary function tests that don't work right can also be used to confirm the presence of disease, especially in patients whose chest x-rays are normal. Few studies were done to find a link between the HRCT pattern and how well the lungs work. Hansell et al. tried to find a link between the pattern and extent of abnormalities on HRCT and pulmonary function tests in subacute and chronic hypersensitivity pneumonitis. They found that areas of decreased attenuation and mosaic pattern are important CT findings that correlate to obstructive functional abnormalities. Also, HRCT pattern and pulmonary function tests in scleroderma and rheumatoid arthritis have been looked at in more recent studies.

The aim of this study is to correlate the radiological pattern and extent of involvement of lung diseases with pulmonary function tests and verify the radiological functional relationship.

MATERIALS AND METHODS

The study was conducted in a Radiology department of tertiary healthcare hospital in Central India.

Data Source: Study of 30 patients with clinical suspicion of Interstitial Lung Disease who are referred to the Department of Radio-diagnosis for HRCT thorax and fulfilling the inclusion and exclusion criteria of patient selection.

Study Design: Cross-sectional study.

Inclusion Criteria

1. Patients referred/ admitted to the institution with clinical suspicion of interstitial lung disease requiring HRCT Thorax.
2. Patients who had given consent.

Exclusion Criteria

1. Unstable cardiovascular status (because Forced Expiration may worsen angina /BP).
2. Thoracic /Abdominal/ Cerebral Aneurysm.
3. Recent Surgery (Abdominal/ Thoracic).
4. Active Tuberculosis / Carcinoma lung / Pneumonectomy.

Ethical Justification For Study

The study was carried out only after approval by Institutional Ethical Committee of this tertiary care institute.

DISCUSSION

Diffuse parenchymal lung diseases (DPLD) are a group of different lung diseases that have similar clinical, roentgenographic, physiological, or pathological symptoms. These lung diseases are also called "interstitial lung diseases" (ILD). DPLD change how the lungs move and how they exchange gases. In general, DPLD is marked by restrictive changes in pulmonary physiology, such as a decrease in total lung capacity, residual volume, static compliance, vital capacity, and often an increase in the FEV1/FVC ratio and a decrease in carbon monoxide diffusion capacity.

In the present study, the highest frequency of age was 50-60 years (36.7%). In a study by Isaac BT et al, the mean age of the patients enrolled for the study was 53 years. In a study by Danna D et al, the mean age was 67. 36 years.

In as study by Occhipinti et al, the mean age of the patients enrolled for the study was 70 years.In a study by Park k J, the mean age of the patients enrolled for the study were in mean age of 52 years.

In the present study, the maximum number of patients who were included in the study were male (70%). However, in the study by Isaac B T et al , the gender who had participated in the study in maximum numbers were female (51%). [1]

In the present study maximum patients had breathlessness (86%). However in the study by Isaac B T et al it was observed that among the patients with diffuse parenchymal lung diseases who were included in the study, the patients having breathlessness were very less 21%. [1]

In the present study it was observed that among the patients with diffuse parenchymal lung diseases who were included in the study, maximum patients had cough (76.7%)

In a study by Isaac BT et al, it was observed that the percent among the participant patients enrolled for the study who had cough were 6%[1]

In the present study, maximum patients had history of smoking (70%). In a study by Occhipinti et al, the patients enrolled for the study had the history of smoking (52%). [3]. In a study by Isaac BT et al, percent among the participant patients enrolled for the study who were smokers were 6%[1]. In a study by Park k J, the percentage of patients enrolled for the study who had the history of smoking were 23%.

Maximum patients had Underlying systemic disease (83.3%). In a study by Isaac BT et al, percent among the participant patients enrolled for the study who had underlying Systemic diseases was 88%[1]

Maximum patients had UIP (46.7%). Similarly In a study by Isaac BT et al, it was observed that the majority of the patients had reported with UIP. The percent among the participant patients enrolled for the study who had UIP was 83%[1]. This directs towards the positive correlation with UIP.

The two dependent variables FVC and DLCO, were the best functional parameters associated to the variations of percentage of respiratory dysfunction. In the present study both were assessed. In the present study it was observed that there is presence of positive correlation between FVC and HRCT. FVC has been shown to correlate well with HRCT in a study by Xuabet et al. Also the study by Mura M et al showed that there is correlation between HRTC and FVC. In the study by Xaubet et al, FVC correlated better with ground glassing ($r = -0.58$) than with overall score ($r = -0.46$) similar to our study. In this same study where the researchers also looked at the follow up of patients with treatment, FVC variation over a period of time significantly correlated with corresponding variations in HRCT ($r = -0.51$). The study by Mura et al[3] also found good negative correlation of both TLC and FVC with HRCT scores. In our study too we found good correlation of both FVC ($r = -0.48$) and TLC ($r = -0.439$), the former being better than the latter. Hence FVC is a PFT measure which correlates well with HRCT scores, even better than TLC.

In the present study, the correlation observed to DLCO was 49.67%. In a study conducted by Wells et al., where the study

had included the largest sample size among the many studies which were carried out at various levels, found DLCO % of predicted to correlate well with HRCT of patients without emphysema (r = −0.68). Staples et al. studied 23 patients and found DLCO to correlate well (r = −0.64) with HRCT (visual analogue scale of 0-100%). In a study by Isaac B [1] demonstrated a better significance or a larger r value (r = −0.721) for correlation of DLCO % of predicted with HRCT. Since IIP is associated with loss of alveolar volume, correcting for alveolar volume underestimates the lung damage. So through that particular study, it was shown that, DLCO correlates better with HRCT rather than DLCO/VA.

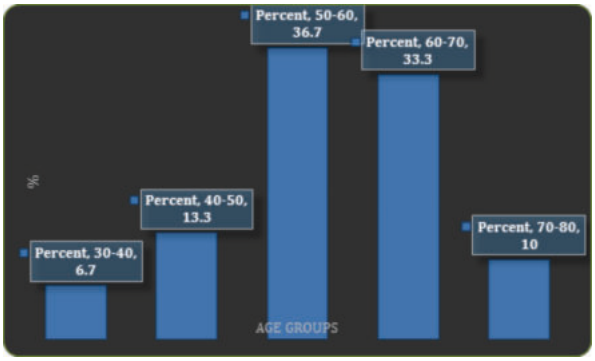
Similarly, in a study by Occhipinti et al, the patients enrolled for the study presence of positive correlation between FVC and HRCT (24%).

In the study by Park KJ et al, [5] visual inspection scores correlated more closely with DLCO (percentage of predicted) and FEV1/FVC than did either the 2D or 3D analyses. In a study conducted by Mu¨ller et al ,also found visual scoring of emphysema to be comparable in accuracy to the 2D density mask method correlated with pathologic scores. However, visual inspection is known to be affected by observer experience, by interobserver and intraobserver variability, and by technical factors such as window settings. Correlation between each of the lower attenuation volume thresholds and pulmonary function measurements was similar to lower attenuation areas measured by others with the density mask ., The study by Gould D etal, explains about the tissue (the volume of airspace walls) within a defined volume of the lung region. If the airspace walls are not abnormally thickened, then in turn the density will also depend upon the size of these distal airspaces, as larger airspaces will clearly mean less airspace wall within a given volume of the lung. We used direct histologic examination (figure 1OA-C), as has been recommended (1), to exclude thickening in the walls of distal airspaces, as seen in the randomly selected blocks taken from resected lungs or lobes.

1. Age Wise Distribution Of The Study Participants

	Frequency	Percent
30-40	2	6.7
40-50	4	13.3
50-60	11	36.7
60-70	10	33.3
70-80	3	10.0
Total	30	100.0
mean±SD	57.83±10.93	Range (31-80)

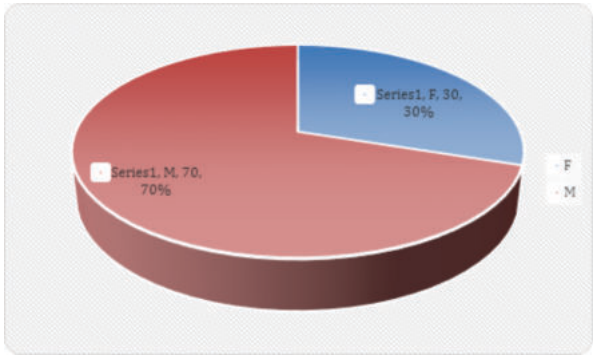
In the present study, the highest frequency of age was 50-60 years (36.7%) followed by 60-70 years age (33.3%) and 40-50 years age (13.3%). Mean age was 57.83 year



2. Gender Wise Distribution Of The Study Participants

	Frequency	Percent
F	9	30.0
M	21	70.0
Total	30	100.0

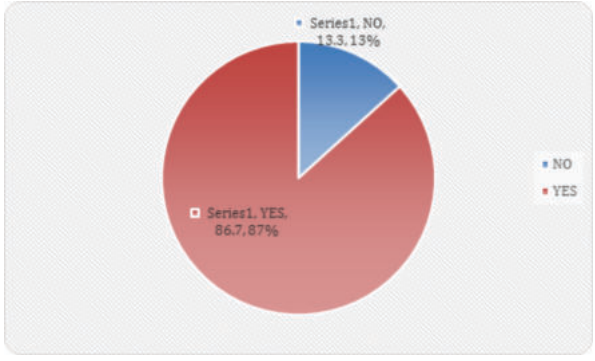
In the present study, maximum patients were male (70%)



3. Breathlessness Wise Distribution Of The Study Participants

	Frequency	Percent
NO	4	13.3
YES	26	86.7
Total	30	100.0

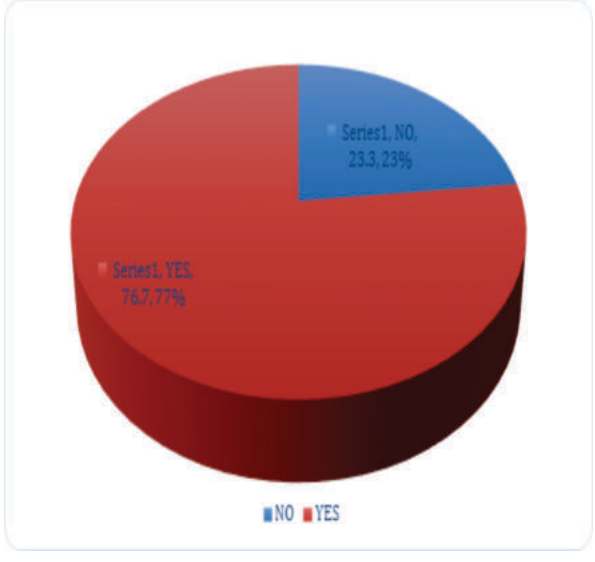
In the present study, maximum patients had breathlessness (86.7%)



4. Cough Wise Distribution Of The Study Participants

	Frequency	Percent
NO	7	23.3
YES	23	76.7
Total	30	100.0

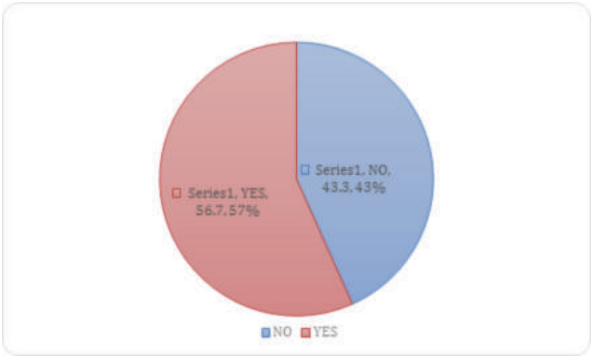
In the present study, maximum patients had cough (76.7%)



5. Chest Pain Wise Distribution Of The Study Participants

	Frequency	Percent
NO	13	43.3
YES	17	56.7
Total	30	100.0

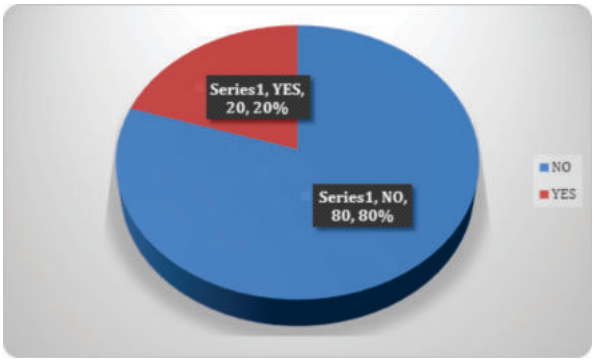
In the present study, maximum patients had chest pain (56.7%)



6. Fever Wise Distribution Of The Study Participants

	Frequency	Percent
NO	24	80.0
YES	6	20.0
Total	30	100.0

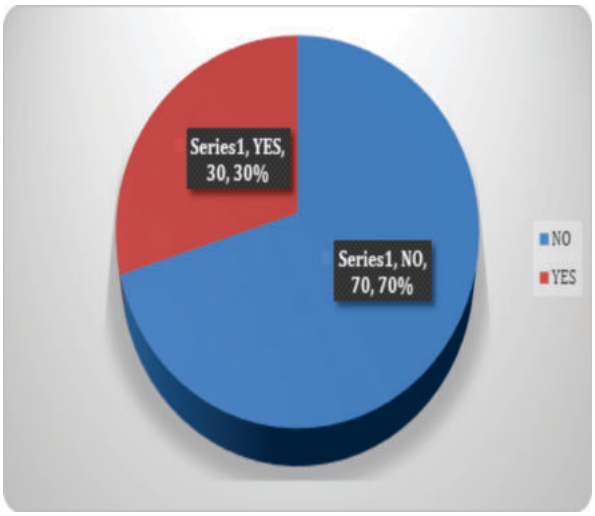
In the present study, only few patients had fever (20%)



7. H/O Smoking Wise Distribution Of The Study Participants

	Frequency	Percent
NO	21	70.0
YES	9	30.0
Total	30	100.0

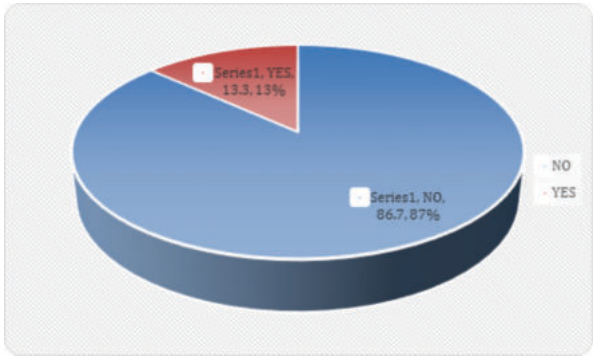
In the present study, only few patients had history of smoking (30%)



8. H/O Infection Wise Distribution Of The Study Participants

	Frequency	Percent
NO	26	86.7
YES	4	13.3
Total	30	100.0

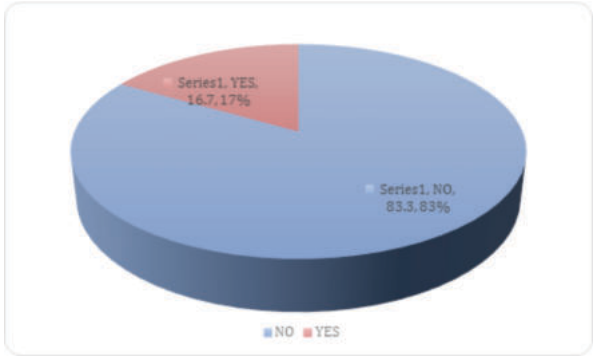
In the present study, only few patients had h/o infetion (13.3%)



9. Underlying Systemic Disease Wise Distribution Of The Study Participants

	Frequency	Percent
NO	25	83.3
YES	5	16.7
Total	30	100.0

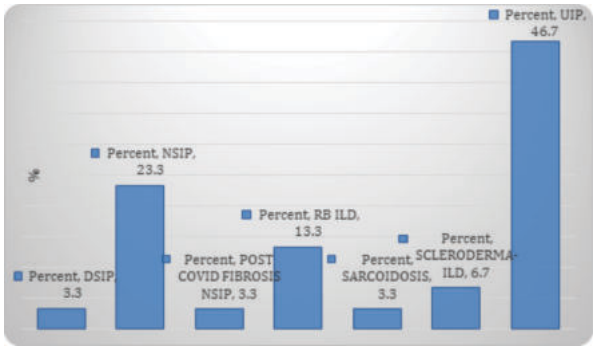
In the present study, only few patients had Underlying systemic disease (16.7%)



10. Diagnosis Wise Distribution Of The Study Participants

	Frequency	Percent
DSIP	1	3.3
NSIP	7	23.3
POST COVID FIBROSIS NSIP	1	3.3
RB ILD	4	13.3
SARCOIDOSIS	1	3.3
SCLERODERMA-ILD	2	6.7
UIP	14	46.7
Total	30	100.0

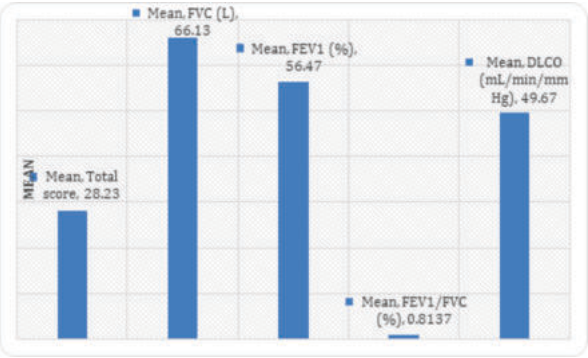
In the present study, maximum patients had UIP (46.7%) followed by NSIP (23.3%) and RB ILD (13.3%)



11. Descriptive Data Of The Study

	Minimu	Maxim	Mean	Std.
Total score	10	45	28.23	7.824
FVC (L)	44	112	66.13	22.844
FEV1 (%)	25	100	56.47	17.683
FEV1/FVC (%)	.40	.90	.8137	.11690
DLCO (mL/min/mm	35	64	49.67	8.523

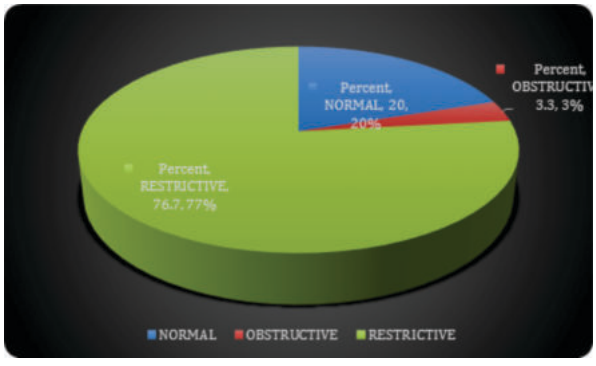
In the present study, mean FVC was 66.13 l, mean FEV1 was 56.47 %, mean FEV1/FVC was 0.81% and mean DLCO was 49.67 mL/min/mm Hg.



12. Interpretation Wise Distribution Of The Study

	Frequency	Percent
NORMAL	6	20.0
OBSTRUCTIVE	1	3.3
RESTRICTIVE	23	76.7
Total	30	100.0

Maximum patients had restrictive (76.7%) followed by normal (20%) and obstructive (3.3%)



13. Comparison Between Interpretation And Diagnosis

			Interpretation			Total
			Normal	Obstruc-tive	Restric-tive	
Diag-nosis	DSIP	N	1	0	0	1
		%	16.7%	0.0%	0.0%	3.3%
	NSIP	N	0	0	7	7
		%	0.0%	0.0%	30.4%	23.3%
	Post Covid Fibrosis Nsip	N	0	0	1	1
		%	0.0%	0.0%	4.3%	3.3
	RB ILD	N	0	1	3	4
		%	0.0%	100.0%	13.0%	13.3%
	Sarco-idosis	N	0	0	1	1
		%	0.0%	0.0%	4.3%	3.3%
	Sclero-dermaild	N	2	0	0	2
		%	33.3%	0.0%	0.0%	6.7%
	UIP	N	3	0	11	14
		%	50.0%	0.0%	47.8%	46.7%
Total		N	6	1	23	30
		%	100.0%	100.0%	100.0%	100.0%

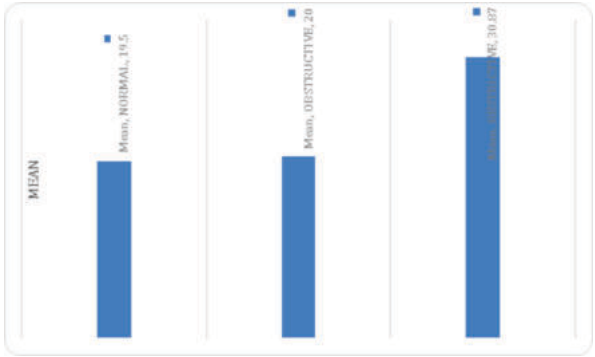
P value=0.01 (S)

In the present study, normal interpretation (6) was seen in DSIP (1), SCLERODERMA-ILD (2) and UIP (3). Obstructive interpretation (1) was seen only in RB ILD (1). Restrictive interpretation was seen higher in NSIP (7), RB ILD (3) and UIP (11). Comparison between interpretation and diagnosis was showed statistically significant results.

14. Comparison Between Interpretation And Total Score

	Mean	Std. Deviation	P value
NORMAL	19.50	6.921	0.001 (S)
OBSTRUCTIVE	20.00	.	
RESTRICTIVE	30.87	6.218	

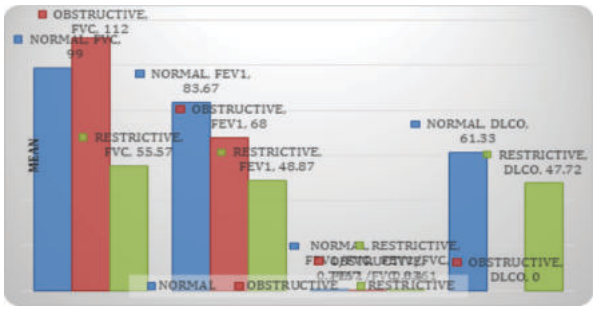
In the present study, total score was higher in restrictive (30.87) followed by obstructive (20) and normal (19.5). Comparison between interpretation and total score was showed statistically significant results.



15. Comparison Between Interpretation And Spirometry

	FVC		FEV1		FEV1/FVC		DLCO	
	Mean	Std. Devi	Mean	Std. Devi	Mean	Std. Devi	Mean	Std. Devi
NORMAL	99.00	13.784	83.67	9.933	.7967	.08824	61.33	3.055
OBSTRUCTIVE	112.00	.	68.00	.	.4000	.	0	
RESTRICTIVE	55.57	11.735	48.87	11.026	.8361	.08866	47.72	7.505
P value	0.001 (S)		0.001 (S)		0.001 (S)		0.007 (S)	

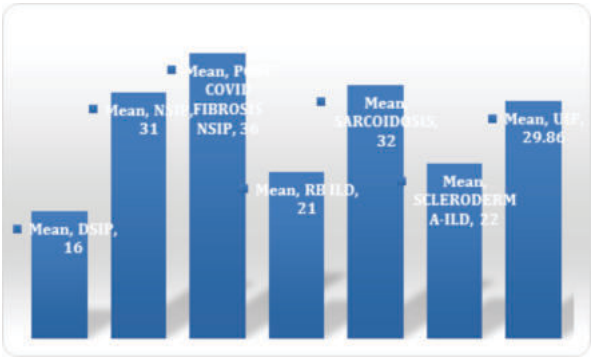
Comparison between interpretation and spirometry profile (every parameter) was showed statistically significant results.



16. Comparison Between Diagnosis And Total Score

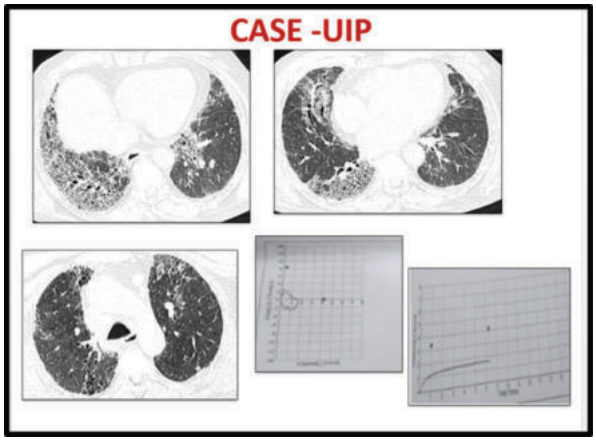
	Mean	Std. Deviation	P value
DSIP	16.00	.	0.11
NSIP	31.00	3.651	
POST COVID FIBROSIS NSIP	36.00	.	
RB ILD	21.00	1.414	
SARCOIDOSIS	32.00	.	
SCLERODERMA-ILD	22.00	5.657	
UIP	29.86	9.012	

In the present study, higher total score was showed in POST COVID FIBROSIS NSIP (36), SARCOIDOSIS (32), NSIP (31) and UIP (29.86). Comparison between interpretation and total score was showed statistically significant results.

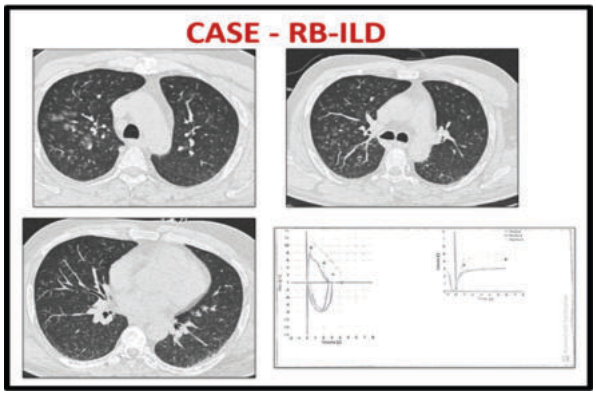


Few Representative Cases

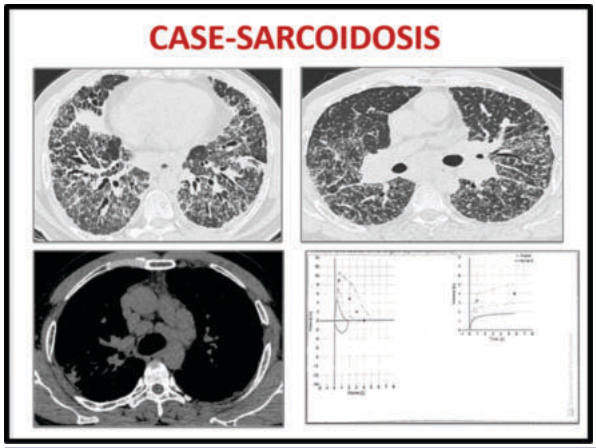
CASE 1



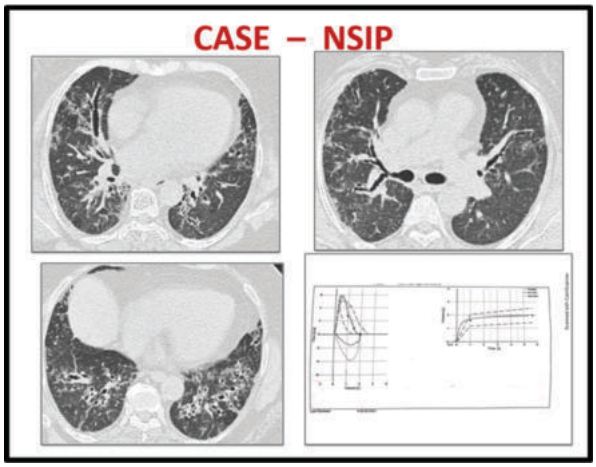
CASE 2



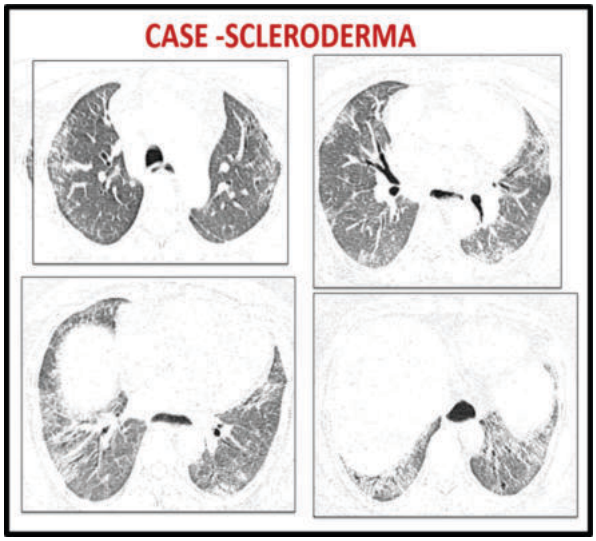
CASE 3



CASE 4



CASE 5



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